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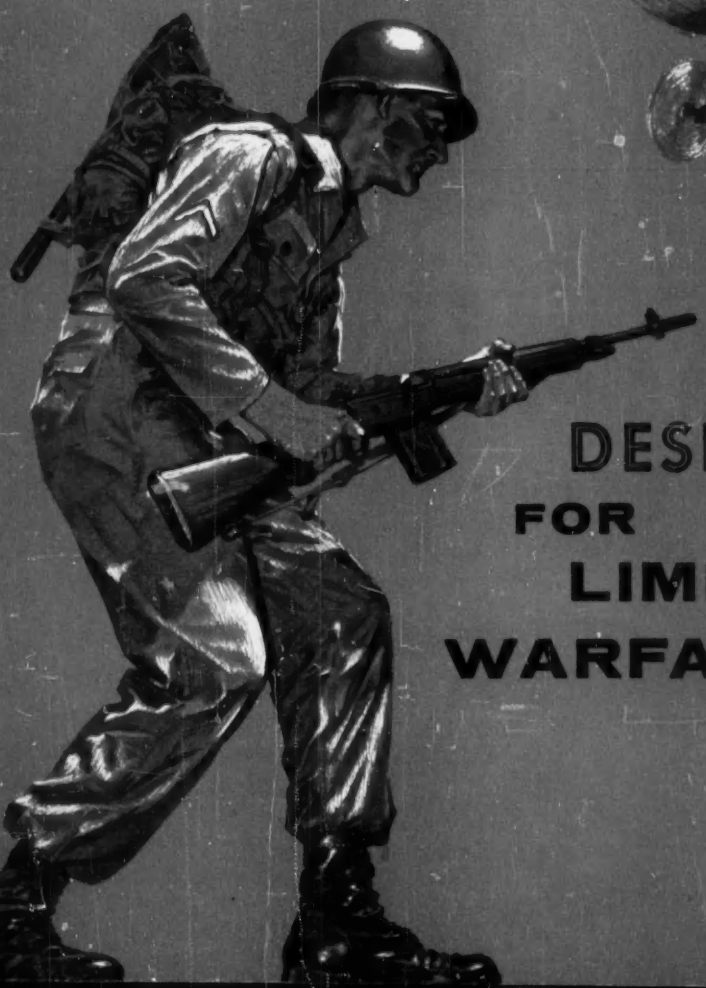
R and D RESEARCH AND DEVELOPMENT edition

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

LESTER PEARSON | DUNCAN SANDYS | DR. HAROLD UREY | DR. VANNEVAR BUSH | DR. ARTHUR COMPTON

Should the U. S. share scientific secrets?.. *see page 36*



DESIGN FOR LIMITED WARFARE...

see page 19

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Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT edition

December 30, 1957 Vol. 28, No. 26

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Product Engineering ..... SIDELIGHTS

Research and Development edition

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●**Ten influential men** were interviewed for this week's Points of View (p. 36). Some were more cooperative than others—which is understandable considering the sensitivity of the subject. The shortest response was the clipped one from a Navy admiral working closely with AEC. "I can't answer that!" he said. "What would you say if I asked if you think your editor should be fired?" Our interviewer sputtered, choked, said "Thank you, sir," and hung up.

●**Machine operators** are now being studied with the same deep analysis as the machines they serve (p. 34). Even engineers are getting the magnifying-glass treatment, and with interesting results. A recent article in a Canadian newspaper has this disheartening news: "The storybook wardrobe of engineers—knee-length boots, breeches and pipe— has long since been replaced by the lounge suit and dinner jacket." That's fashion for you, but we're darned if we'll give up our pith helmet.

●**"Limited warfare"** (p. 19) sounds rather like a very dangerous game. Yet despite the danger, service men still supply some of our best American humor. Latest report is of a VC-6 Navy tanker plane with a winged gas-station pump painted on the fuselage. Beneath the pump they wrote the heartwarming motto—"We give S-H green stamps."

●**At the Chemical Industries Exposition** in New York early this month Fansteel Metallurgical Corp. lost what is believed to be the largest columbium ingot ever made. The bar is 3 in. dia, 14 in. long and weighs 28½ lb. It was produced by a new and still-secret Fansteel process and, while worth about $5000 to Fansteel, is of absolutely no value to anyone else. If it dropped in your trouser cuff during your visit to the Fansteel booth they would be grateful for its return.

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READER TO EDITOR

Selling Management Is Murder

To the Editor:

Regarding Mr. Auerbach's letter (Nov. 18, p. 4) concerning the difficulty in trying to get new product ideas over to most companies, I agree with every word he writes. Sales Depts. get all steamed up over a new product, pass it to their Engineering Depts. for appraisal and they, feeling their job is in jeopardy, kill the whole thing dead by a first-degree-murder report to Management.

For example, we in Canada have had some ghastly fires with tragic losses of life and property. After one such bad fire I was talking to a fire chief and he asked why some scientist did not invent a good, cheap, flash and smolder fire-detector that would be reliable yet foolproof over a temperature range of −60 F to 140 F, the point of danger for self-combustion in most cases. I thought about it, experimented, and came up with an idea which I patented. Models tested proved it foolproof against alarm (false) over sustained or shock vibration; therefore suitable for vehicle usage—and it can be produced even in small lots for less than $1. The fire departments and insurance people who saw it were highly pleased, rated it the best seen in years and meeting all requirements—now all that was left was to get some company to make and market it. All that I would have asked from its sale was to be able to cover costs.

The *Financial Post* gave it a very good write-up. One fire equipment company became very excited—"just what they needed to complete their range!" It was passed to their Engineering for appraisal. The report condemned it because "it did not have microadjustments on the settings—it was too simple to work." Models for test were refused. A large US company had drawings, write-ups, etc., then asked for a number of models to be made up for test. I had these made and sent. After months of no answers to my letters the models were returned, unopened, with a brief note from the Chief Engineer—"of no use to our range!"

At this point I gave up, having come to the decision that the private inventor is just wasting his time and money trying to get his idea past any company with an Engineering Dept. —you could not even give the idea away for the smallest development cost. If Dr. Warren Beck or anybody else knows how to overcome this loss to industry, most inventors would appreciate an article on the secret.

—NAME WITHHELD

How About Selling Some Samples?

To the Editor:

I first thought of the following as an item for your "Why Don't They . . ." However, it is not in the R & D field.

Why don't companies make standard-package, small-quantity sample lots available at pre-set advertised prices for standard stocked items advertised in technical magazines? Let us say I am working on a new super automatic widget. For this I need 10 elastic stop nuts, or a couple of special relays or a miniature thermostat and I see precisely the thing I want advertised in your magazine (or another). I can write as Ontario Hydro (my company), and after checking in the rating books the salesmen swarm in like ants to a picnic. But if I write as E. G. Price, Professional Engineer, I get no answer at all.

Now I know that to process my original letter, answer it, quote prices, accept an order for 10 lock nuts and process it, send acknowledgement slips, shipping notices and invoices (plus customs forms for shipping to Canada) would cost the company roughly $10. This is why some companies send out free samples; it's cheaper to give a small lot away than to sell it.

Getting things free is fine; I wouldn't want to say anything against it. What do I do, though, if I get six items as a free sample, and I need three more? Would it be possible to have samples, in pre-packaged small lots, which would be shipped against a cash order? This would involve no paperwork, no fuss, and strictly cash with order; the arrangement would, of course, apply to standard stock items only.

—ELBERT G. PRICE
Toronto, Ontario

Industrial Designer's Dilemma

To the Editor:

In a recent issue there appeared an article describing the need for Industrial Design talent within industry (Oct. 7, p. 28). As a graduate in Industrial Design from an accredited university, I find myself forced to work outside my field due to the fact that the West Coast does not yet demand the design talent to which the article referred. I want to work in the Industrial Design field—regardless of area location.

—DONALD L. MAGARGEE
Los Angeles, Calif.

Aspire to This Height

To the Editor:

The evidence of a blind spot as big as that shown by your correspondent, Nathaniel Archer (Reader to Editor, Dec. 2, p. 4) would be amazing if it were not so frequently met. He defines an engineer as "one who applies (physical) laws . . . assisted by others of lesser status called 'designers' and 'draftsmen.' I suggest that reflection will show that the title 'designer' applies (in the usage of engineering) to one who employs his knowledge of the physical laws creatively. To be a designer is the height to which engineers should aspire.

An engineer per se is known as one who is versed in "engines" in the classical sense ("engines of war" as an instance; that is to say, mechanisms) and by extension, versed in the work of engineering whether civil, mechanical, electrical or which you will. This does not imply "to be able to design." The capacity for original and independent thought is the most rare of all talents, it is odd that it has fallen into such disrepute. Ettore Bugatti considered himself the designer of the remarkable cars which bore his name; Mitchell would have hardly had himself known as other than the designer of such a masterpiece as the Spitfire, although he most assuredly was assisted by a corps of draftsmen, stressmen, aerodynamicists, and other specialists. Nor is this definition to be considered so rigorous as to exclude other branches of engineering. Dr. De Forest was certainly the designer

of the detector tube. The Roeblings were designers of the Brooklyn Bridge, and W. F. Gibbs would be distressed, I am sure, were any one to arrogate to himself the title of designer of the ship *United States*.

Mr. Archer should live so long that he might walk in the company of men such as these. So should we all.

—KENNETH MEYER
Richmond Hill, N. Y.

German Paternosters

To the Editor:

With regard to the single-shaft elevator letters (Nov. 4, p. 60; Nov. 18, p. 4), here is a picture taken in October of the Paternoster elevator in the new city hall of Regensburg (Germany). This elevator could be ridden through the attic as well as the basement: there was a sign assuring passengers that it was safe!

—R. S. HARTENBERG, *Professor*
Dept. of Mechanical Engineering
Northwestern University
Evanston, Ill.

• These individual elevator shafts seem to be more widespread in Europe than we had imagined. Anybody know of any in this country? Incidentally, the name *paternoster* is Latin for the Lord's Prayer. Anybody riding in this type of lift was advised to first utter a *paternoster*—Ed.

In the Interest of Fair Play

To the Editor:

The double-page spread on simplified drafting (Nov. 18, p. 42) is eye-catching, but makes a bad impression. Your title "Points of View" suggests that you recognize that there are two sides to this question, but you give the point of view of one educator and oppose him with points of view of four industrialists.

In view of the fact that the vast majority of industry does not (at least as yet) subscribe to "simplified drafting," I feel that some representation of their point of view might be presented in the interest of fair play.

—H. C. SPENCER, *Director*
Department of Technical Drawing
Illinois Institute of Technology

• *We too believe in fair play, but in this game had trouble finding opponents.—Ed.*

Collapsible Scooter for Boats

To the Editor:

That collapsible motor scooter (Dec. 2, p. 33) was developed, I believe, by Evinrude, who of course make outboard engines. The prime purpose of this collapsible motor scooter was to be able to put it on a cruising boat—just a plain pleasure boat—so that they could have instantly available some convenient land transportation wherever they happened to stop.

—ANSON E. MEANOR
Chicago, Ill.

Hand Drier for the Home

To the Editor:

The answer to Mr. V. J. Perillo's request (Why Don't They . . . Dec. 2, p. 50) is a product called "OZO DRYER" manufactured by Ozo Sales Corp., New Haven, Conn. (Mr. Perillo suggested a home hand drier containing a small blower—Ed.) The only difference is that a contact button, instead of a photo-cell, is used to operate it.

An item which many engineering departments would find useful would be the development of an emulsion for photo-enlarging paper or film, which could be developed in semi-darkness in the conventional B/W or Ozalid blueprint machinery instead of the usual wet-bath chemicals.

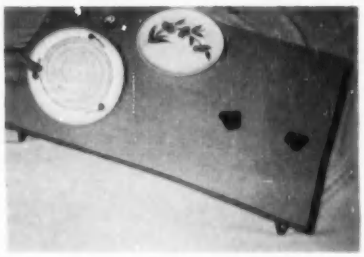
—M. O. YOUNG
All American Engineering Co.
Wilmington, Del.

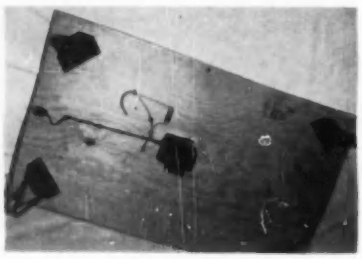
Hot Dinnerware

To the Editor:

In reference to the suggestion by Kenneth Kahn for heated dinnerware in your "Why Don't They Research and Develop" column (Dec. 2, p. 50), we are pleased to inform you that we hope to put this product on the market next year. Here is a description and photographs of our product.

—WILLIAM B. READEY
Heat On Tripod Dinnerware
Berkeley, Mo.





• The plate has a metallic resistance-heating circuit printed on its bottom and connected to three conductive feet. A 12-v differential between one metal foot and either or both of the others sets current flowing and heats the plate. Power comes from a transformer mounted under the table and directed to contact areas in the table surface. Table cloths with conducting wires, place mats or even aluminum foil do-it-yourself contactors may be used to bring current to the plate.—Ed.

"Sorry to see you go, Smith—it's hard to replace a man with a master's degree at the salary I've been paying you."

American...

DEVELOPMENTS TO WATCH...

Here's what to expect in '58 . . .

. . . from developments announced this year:

• Broader-range lubricants, for all kinds of power plants, including nuclear reactors, will emerge from the laboratory. Among them: another new "atom grease," this one based on synthetic diesters rather than petroleum or silicone compounds, that stands temperatures to 300 F or more as well as resisting nuclear radiation (Dec. 16, p. 14); and a series of silicone-based high-temperature oils and greases for the 600 to 700 F range.

• Flat TV screens, new picture-projection systems, and more efficient light-amplifiers will come a step closer as research on electroluminescence continues (Aug., p. 201), developing new types of phosphors and increasingly efficient activation systems.

• A major breakthrough in molybdenum technology, permitting use of the metal in air at considerably higher temperatures than is now possible, may be announced by year's end. Now in the laboratory are coatings that provide long-term protection in oxidizing atmospheres at 1800 to 2000 F. Thermal shock resistance still leaves something to be desired; but a new approach—development of alloys that provide a better coating base and seem to reduce the tendency toward cracking—looks most promising.

• New ways to join dissimilar metals—both adhesives and welding—will do much to eliminate this problem as a design limitation (Oct. 14, p. 9, and Nov. 4, p. 6).

• Tighter specifications on drilled holes and milled surfaces, with a much lower cost premium, should be possible because of new cutting-tool materials and cutting-tip designs (Nov. 4, p. 6).

• Increased use of radioactive materials in product design—as signal lights and markers, in "atomic batteries" and the like—is forecast by new isotope-processing facilities, now scheduled to be in production by early spring (Sept. 16, p. 9, and Dec. 16, p. 5).

• The AEC expects to make cesium 137 available in "multi-kilocurie quantities," and to be able to offer strontium 90, krypton 85 and promethium 147 at reduced prices.

Control-rod drives of at least five types . . .

. . . are being evaluated for nuclear reactor use, could prove useful in other applications as well. Here's what they are, and how they solve the key problem of sealing against leakage:

Canned-motor drives, used on the atomic submarine and first power reactor, separate rotor from stator, and literally enclose the rotor in a metal can (photo below).

Rotary-seal drive, is in the Army's "packaged" power reactor. It has a commercial motor that drives a pinion through a labyrinth-type, low-friction, high-pressure rotary seal. An external electromagnetic clutch is used to connect the gearmotor to the drive.

Linear-seal drives, installed on the Experimental Boiling Water Reactor, are basically similar to rotary-seal type. These, too, use electromagnetic connection, with a labyrinth-type linear seal.

Magnetic jack drives eliminates the seal by using electric motors of the incremental-motion type to operate the drive unit—a pressure thimble, magnet coils, and two magnetic armatures.

Harmonic Drive (Dec. 9, p. 9) also eliminates the seal, by exerting external pressure on the reactor tank to turn the rod installed inside.

Canned motor pump handles sealed-drive problem by enclosing both stator and rotor in welded containers, allowing water to flow between. Westinghouse is building these units for prototype of nuclear-powered vessel.

American ...

(continued)

DEVELOPMENTS TO WATCH...

Another approach to corrosion protection . . .

. . . for such metals as columbium, tantalum, tungsten, and molybdenum at temperatures of 1500 to 3000 F is a special cladding technique now under study at Stanford Research Institute. As SRI metallurgists point out, coatings of stainless steel, high-nickel, and cobalt can stand temperature of 2500 F or more, but getting them onto the more-reactive base metals is a difficult problem. At cladding temperatures, the base metal reacts with even minute percentages of atmospheric gases and tends to become weak and brittle.

The SRI solution: brazed cladding, applied with the aid of a high-vacuum melting furnace.

Coatings applied this way are said to show excellent adhesion, even when test samples are bent to a full U shape.

Skull and crossbones will be worn . . .

. . . by more products next year than ever before if present legislative plans go through. There's likely to be action on both state and Federal levels; and it could lead to plenty confusion. Manufacturers and technical associations, following the situation closely, point out a product barred from one state might sell freely in an adjacent one; or be held to different safety standards under state and Federal law.

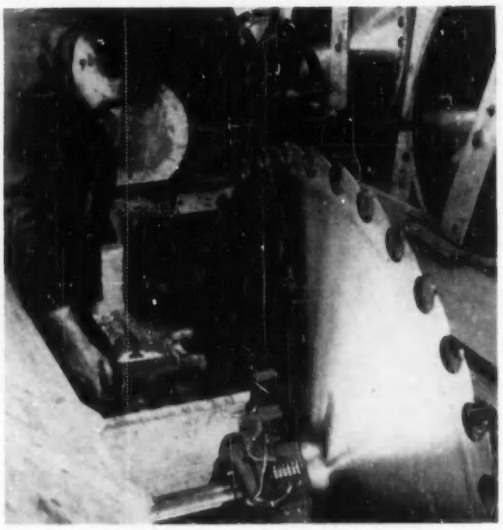
Thus far, only about 10% of the states have labeling laws that apply to industrial products as such, but more than half the states control caustics and other chemicals. And, as Dr. Bernard E. Conley of the American Medical Association's Committee on Toxicology points out, "state legislation on the labeling of chemicals is a hodgepodge of laws . . . often overlapping and sometimes contradictory."

The AMA has prepared, and is promoting, a uniform state labeling code. The Manufacturing Chemists' Association is doing the same on both state and Federal levels, and many other societies are active in the field. This is an area that deserves close attention in months ahead, as various legislative bodies get down to business.

Strain gages guide sawmill design . . .

. . . at the New York State College of Forestry. Variation in materials being worked and the basic design of the equipment itself made it hard to apply conventional measuring equipment. Now, an SR-4 torquemeter replaces conventional power-input devices, a resistance-type load cell is mounted at the cable feed pulley, and a special headsaw bearing (see photo) carrying two strain gages is installed. With these, Baldwin-Lima-Hamilton's Electronics & Instrumentation Div. says it's possible to measure power requirements of the machine, and also to determine the strain on the headsaw and the force with which the feed carriage pushes a log into the saw blade.

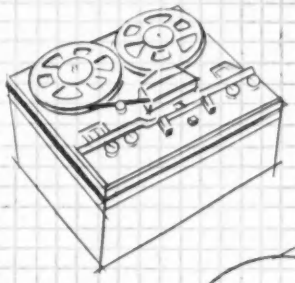
The French, too, are taking a new look at woodworking machinery—with particular reference to chip formation. At the Centre Technique Forestier Tropical, ultra-high-speed photographs stop motion of the saw tooth just as it cuts off a chip. They're using the 25,000-volt discharge from a condenser as a light source, and taking pictures right through the spark gap. Electrical contacts mounted in series synchronize the flash with emergence of the saw tooth from the wood. —ARG

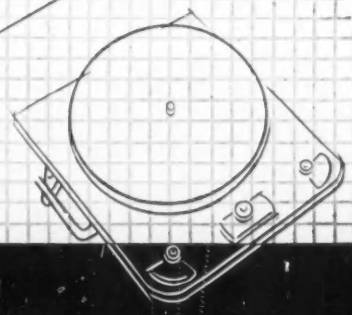


Strain gages are incorporated in special main saw bearing to measure vertical and horizontal strain. Big problem here was mounting electrical leads firmly enough so vibration would not throw them off.

A new standard in

HYSTERESIS MOTOR DESIGN





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- Low Noise Level approaching Inaudibility.
- High Starting Torque for instantaneous efficient operation.

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	WC2913H Turntable	WC2913H-1 ** Tape Recorder
Volts	115	115
CPS	60	60
Watts Input	21	24
Amperes	.25	.22
Number of Poles	4	4
RPM	1800	1800
H.P.	1/150	1/125
T.P.I. (oz. in.)	3.0	4.5
T.P.O. (oz. in.)	3.5	5.0
T.ST. (oz. in.)	2.3	4.0
Capacitor (mfd) 220 Volts A. C.	1	2.5
Weight	1 lb.	1 lb.

*All specifications are relative to frame size. The hysteresis series is available in seven frame sizes from 3/8" diameter to 4 1/2".

**Can be supplied with magnetic shielding (Mu-Metal)

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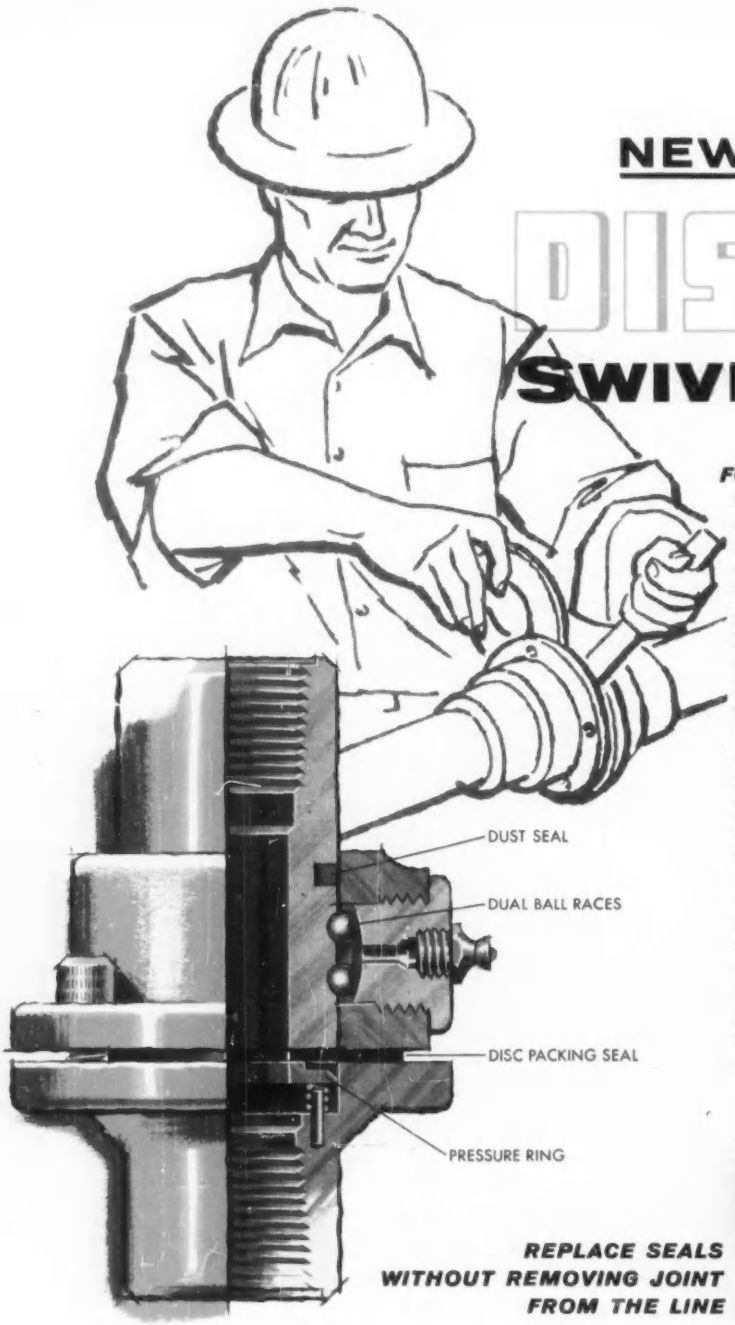
NEW CHIKSAN DISCPAK SWIVEL JOINTS

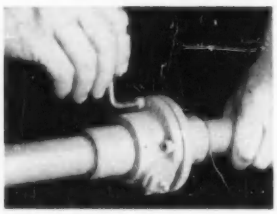


FOR STEAM AND HOT GAS SERVICE

Created specifically for service on lines employed in steam and hot gas service, the Chiksan Discpak embodies a new construction design which permits packing units to be replaced without removing the joint from the line. The outer housing of the Discpak is cut apart at the packing chamber and both ends are flanged at the cut. Four allen-type cap screw bolts are used to secure the flanges. A disc-seal, housed between the two members, provides a fluid-tight seal between rotating and stationary members of the Discpak Swivel Joint. A spring loaded pressure plate holds the packing in sealing position against the swiveling member.

The new Discpak has a maximum temperature rating of 600° F. and a maximum pressure rating of 300 psi. All turning movement in the Discpak takes place on a double row of precision ball bearings. Write today for literature and prices. If your plant or equipment lines utilize hot gas or steam, it will pay you to know about this new field-proven Discpak swivel joint.

REPLACE SEALS WITHOUT REMOVING JOINT FROM THE LINE



To replace the disc-seal, simply remove four allen screws and spread line slightly with a flat metal bar.

CHIKSAN

CHIKSAN COMPANY, 330 No. Pomona Avenue, Brea, California
A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

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New Discpak Bulletin 100 describes in detail the many features of this new swivel joint including full mechanical specifications.

57-26

American ...Washington

DEVELOPMENTS TO WATCH...

The US still has its missile problems . . .

. . . despite the Secretary of Defense's go-ahead signal to start production on both the Army's Jupiter and Air Force's Thor intermediate range ballistic missiles. New delays are ahead.

Military spokesmen privately say that they need around $100 million to get the program under way in a hurry. It will have to come from a supplemental appropriation which means waiting for Congress to return.

Unofficial but authoritative sources are saying, too, that Air Force's Thor IRBM production will be held down over the next year to the current target of six monthly rather than rise substantially as originally expected.

Money is not the key factor in the Thor delay. According to the most recent reports, the Secretary of Defense is still not satisfied with its performance. As he puts it, the missile is still not "thoroughly proven."

There are other shifts taking place in the missile field, too. Unofficially, it is reported that the recent Vanguard firing mishap has bolstered the growing trend in rocketry toward solid fuels in preference to liquid propellants.

It has not been said directly, but the liquid oxygen used to fuel the first stage of Vanguard is generally believed to have been a big cause for the highly-publicized firing failure. Reason is that if the rocket is not fired shortly after it is fueled, other parts are subjected to freezing up. And the military does not want low-temperature fatigue problems hanging over their heads for combat weapons.

More money . . .

. . . is scheduled for government scientists and technical employees. The Civil Service Commission has already cleared snags to hike the salaries of some 45,000 government scientists and engineers by as much as $1,000 a year at an over-all cost to the government of around $25 million a year.

More important, however, is an unofficial report that the administration will ask Congress for around $500 million to boost both civilian and military wages much in the form recommended in the report submitted by Ralph Cordiner, president of General Electric.

Both measures are designed to get and keep skilled personnel. It has been a sore point with the military for years that they train military personnel only to have industry buy them away.

Disclosures on controlled thermonuclear reactions . . .

. . . can be expected from Washington shortly. The British have talked recently about being barred from discussing the matter by the US. Actually, the British, US and Canadians all are working on similar projects with a free flow of information on progress.

US sources disclaim that the British have got the jump on us. If anything, they say, this country is just as far along, if not farther than the British.

The important thing is that useable power from hydrogen reaction is not far away—a mater of years, not decades. And, it holds wider promise than present atomic power. For one thing, the supply of hydrogen is almost limitless and, just as important, there is no danger of radioactivity in the reaction.

Committee investigations, hearings, and blasts . . .

. . . whenever the opportunity arises, are the forms in which congressional attacks will be made on the administration's handling of the nation's defense program. They will hit their stride early next year and missiles will be hit heavily.

Bulk of the hearings held to date are generally regarded as just setting the stage for the real fireworks next year. It will be hard to sift the real honest searching for answers from outright political ground gaining. Particularly since next year is election time for a big bulk of the Congressmen.

One factor to watch is a race between the administration and Congress to outdo each other on spending programs. The administration will have to push for certain programs—aid to education, defense, etc.—but it is a sure bet that Congress will try to get its own programs adopted, then go to the voters with the credit.

World-wide ...

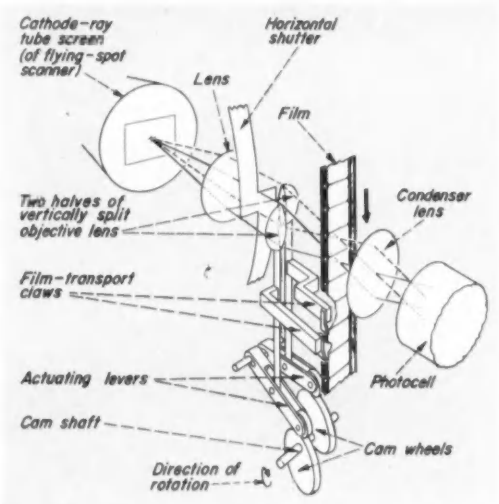
DEVELOPMENTS TO WATCH...

A check-it-yourself system for TV . . .

. . . and a new optical system for film-transmission have been developed in Europe.

The checkup device, called "Bildpilot," is patented by Schaub-Lorenz of West Germany. It shows a wedge-shaped image that expands and contracts much as the radio tuning "eye" did. To produce the image, an electrical impulse is obtained from the line and frame impulse generators and fed to the TV tube. Size of the wedge indicates correctness of tuning because, S-L explains, modulation of the impulse is determined by the amplitude of the picture-IF voltage.

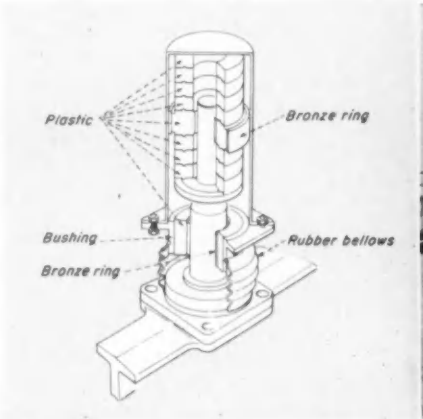
The film-transmission system, designed by the Swiss Federal Institute of Technology for color TV, gets around the problem of the "dark phase" created by space between "frames," while still using the flying-spot type scanner that provides sharpest focus. The device uses a split objective lens coupled with the film-transport claws in such a way that one half of the lens focuses the flying spot on one frame, and the other on the following one to give continuous pickup. Diagram shows setup.

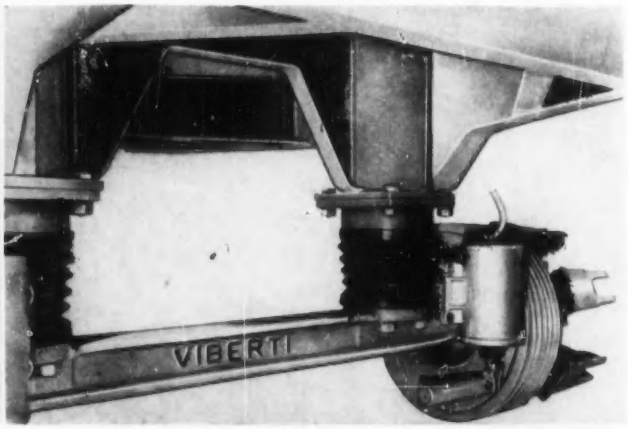


Film-transmission system uses split lens, photocell pickup, compensates for film shrinkage, eliminates dark phase.

New suspension combines plastic pads with . . .

. . . rubber bellows to provide "automatic load adjustment" for trucks, trailers, and buses. Designed by Viberti Officine S.p.A. of Turin, Italy, it's said to reduce tire wear and road-pounding, to be relatively silent in operation, and to require little if any maintenance. It is more expensive than conventional springs, though—adding about 8% to the cost of the vehicle. Viberti does not reveal the plastic used, but does claim that the large plastic rings, fixed in bronze bushings (see diagram), absorb horizontal forces, while the smaller rings, separated by steel disks, serve as conventional springs.





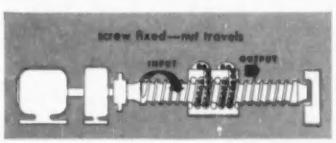
Flexible plastic elements, in cylinder welded to vehicle frame, are designed to absorb horizontal as well as vertical forces. Diagram shows interior construction. In operation, upper bushing and lower rod move as plastic is compressed.

SAGINAW b/b SCREWS

Put "Muscle" into Linear Motion

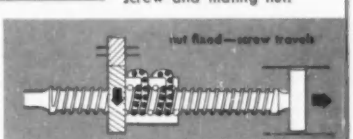
HOW and WHY SAGINAW b/b SCREWS

Actuate and Position with Over 90% Efficiency...4/5 Less Torque



Nut glides on steel balls. Like stripes on a barber pole, the balls travel toward end of nut through spiral "tunnel" formed by concave threads in both screw and mating nut.

At end of trip, one or more tubular guides lead balls diagonally back across outside of nut to starting point, forming closed circuit through which balls recirculate.



1 POWER SAVINGS. Operating with over 90% efficiency, Saginaw b/b Screws permit much smaller motors with far less drain on electrical systems, and also simplify circuitry.

2 SPACE SAVINGS. Saginaw b/b Screws themselves are compact. They permit smaller motors and gear boxes and eliminate auxiliary equipment required by hydraulics.

3 DEPENDABLE PERFORMANCE. Saginaw b/b Screws are far more reliable than hydraulics or pneumatics. Gothic-arch grooves, yoke deflectors and multiple circuits provide added assurance.

4 PRECISE POSITIONING. Saginaw b/b Screws will position components far more precisely than hydraulics or pneumatics; tolerances on position are held within .0006 in./ft. of travel.

5 TEMPERATURE TOLERANCE. Normal operating temperature for Saginaw b/b Screws is from—75°F. to +275°F. But in selected materials, they will function efficiently at temperatures as high as +900°F.

6 LUBRICATION. If lubrication fails the Saginaw b/b Screw will still function with remarkable efficiency. Units have been built and qualified for operation without lubrication.

Saginaw b/b Custom-Ground Screws dependably actuate—with minimum power, weight and space—the flaps and speed brakes on latest airplanes.

JUST ONE OF MANY APPLICATIONS

Because they actuate more efficiently . . . economically . . . dependably than Acme screws, hydraulics or other actuating devices, Saginaw b/b Screws are being specified more and more by progressive manufacturers. Already they have been applied to machine tools, jet engine afterburners, guidance mechanisms, nuclear reactor controls, electronic control equipment—plus a host of other applications. They've been operationally proved. . . and they're backed by all the research and test facilities of the General Motors Technical Center.

SOLVE YOUR ACTUATION PROBLEMS

Re-examine your actuation or positioning needs in the light of better performance, efficiency and economy. If you have a critical or precision application, order custom-machined Saginaw b/b Screws. We have successfully built them from 1½ inches to 39½ feet long—3/16 inches to 10 inches diameter. (If your application requirements are not critical . . . less stringent . . . you may be able to satisfy your actuation needs by ordering from Saginaw's exclusive "off-the-shelf" stock. It's available in seven standard rolled thread sizes, cut to length, for low cost and fast delivery.) What's more, if you're not sure how best to apply Saginaw b/b Screws to your product, Saginaw's experienced engineers will gladly go to work on your problem—without obligation. Just write or phone us or fill in and mail the handy coupon below.

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What's happening in SCIENCE

Electrogravitics: Science or daydream?

A few weeks from now, at a special session of the Institute of the Aeronautical Sciences (New York City, Jan 27-31), a group of dedicated men will discuss what some people label pure science-fiction, but others believe is an attainable goal. The subject: electrogravitics—the science of controlling gravity.

Gravity is certainly a well-known phenomenon. Every schoolboy can "explain" it. Yet it remains a baffling mystery. For instance, as David B. Witty noted in his award-winning essay for the Gravity Research Foundation, gravitational screening is crucial in all theories of gravitation. If there were no way to block out the force of gravity or cut it off, "gravitation would be almost unique among physical phenomena." Yet there is no evidence of gravitational screening in our normal, everyday experience.

Theories proposed to explain this situation, include a complete reversal of conventional ideas. For example, E. M. Gluhareff, Pres. of Gluhareff Helicopters, suggests much progress might come if gravity were considered as "push" rather than "pull"—with all matter being pushed toward the center of the earth by a sort of "electronic rain" from outer space.

Charles Tilgner, Jr., chief aeronautical engineer at Grumman and chairman of the forthcoming IAS session, suggests at least four ways that gravity might be controlled. He asks if the earth itself ever acts as a gravitational shield—a question also raised by Gluhareff's suggestions that gravity be considered as an external force.

Right now, as might be expected, the most promising approach to understanding and control of gravity seems to be via nucleonics. Such recently-discovered atomic fragments as hyperons and k-particles (Dec. 2, p. 16) appear to interact with nuclear matter in ways not explained by present theories. Scientists are now suggesting that these interactions may explain—or be explained by—gravity. It is even possible that gravitational energy may prove to be transformable into particles of this type.

Obviously, control of gravity is not yet just around the corner. Perhaps British aeronautical engineer A. V. Cleaver is right in insisting that if any anti-gravity device is to be developed the first thing needed is a new principle in fundamental physics—not just a new invention or application of known principles.

Nevertheless, the Air Force is encouraging research in electrogravitics, and many companies and individuals are working on the problem. It could be that one of them will confound the experts.

New way to separate isotopes

To anyone who has seen the huge, government gas-diffusion plants built to separate normal uranium 238 from its fissionable isotope, 235, news of a German ultrasonic technique is important indeed—and it may hold possibilities for obtaining other elements in pure form.

Dr. Erwin W. Becker of Marburg University reports that, by pressing "normal" uranium hexafluoride through tiny nozzles (0.1 mm dia) with ultrasonic speed, and using a stripper opening, it's possible to skim off heavier particles from lighter ones. According to Becker, this "jet separation" process can be applied to any gaseous isotope mixture, simply by selecting the proper gas stream pressure and concentration.

Economically, the process cannot yet compete with the gaseous diffusion system used in the US (Becker estimates the energy demand for processing 1 kg of natural uranium at 8800 kwh); but it does hold interesting possibilities. —ARG

Rockets for research

As a source of hot, compressed gases to test heat resistance of materials, and study erosion and corrosion, several companies are now using baby rockets. These small, versatile power packs can provide a fast and relatively low-cost road to high-temperature and high-pressure research.

Another up-and-coming use for the midget missiles is in machine design, and they're even moving into the backyard (see FYI section).

Baby rocket blasts hot gases that test materials at Convair. Installed in sealed, test chamber, it develops a pressure of 700 psi; produces an exhaust stream with theoretical velocity of 8000 fps.

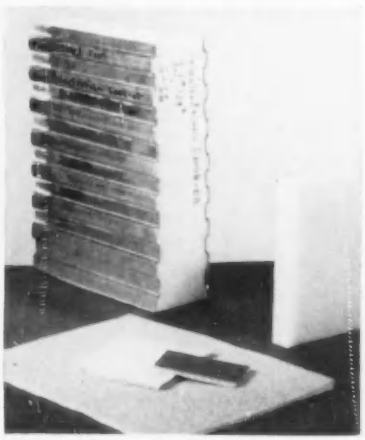
What's happening in MATERIALS

More strength for magnesium

Stronger, better-protected magnesium parts are promised by new coating and heat-treating methods. Dow Chemical Co. reports, for instance, that solution heat-treatment at 930 F for two hr, plus conventional aging, can raise the yield strength of ZK60A forgings as much as 40%, and increase the ultimate tensile strength 5 to 10% as well. As to coatings, Brooks & Perkins reports there are now at least a dozen different electrochemical finishes that provide both temporary and permanent protection and offer a selection of surfaces from dull matter to bright. Among newer ones are Convair's Manodyz, a protective–decorative finish and paint base; and Frankford Arsenal's Cr-22 and HAE, for protection against salt water and elevated temperatures.

New stars in the foam firmament

Take an isocyanate–tolylene diisocyanate, perhaps–react it with a polyester, a polyether, or even castor oil (Dec. 23, p. 9) . . . and you're likely to come up with a new foamed plastic for cushioning, padding, thermal insulation, or structural stiffening.



Flexible and rigid foams of the closed-cell type are produced with new Pittsburgh Plate polyester resins; can be made in slabs a foot or more thick, in densities down to 2 lb per cu ft.

It's not quite that easy, of course, but the variety of materials possible, and their market potential, is encouraging all sorts of companies to try. Newest to aim its hat at the ring is Scott Paper. It has patented a urethane foam which, it says, shows promise as a filtering material, and also has "greater tensile strength and elongation than conventional urethane foams, and a dramatic, wool-like feel and drape." Production facilities are now being set up.

Pittsburgh Plate Glass, supplier of foaming resins, has joined the procession, with "a new series of unique low-cost polyesters." These have, according to C. R. Fay, vice-president of the PPG paint and brush division, "excellent load-carrying capacity at low densities, higher resilience, good freeze resistance, and soft feel."

(For more on foamed plastics, see Sept. 23, p. 5, and Oct. 21, p. 6.)

How cost patterns are changing: metals

Major upheavals seemed in store for metals a few months ago. Steel, aluminum, copper and nickel were all posting price changes. But in the past few months all have settled down–and seem likely to stay put for several months at least. Here's the net effect of the changes this year:

1957 Prices, ¢ per lb	Jan.	Dec.	% change
Steel	3.70	3.85	up 4
Aluminum	27.10	28.10	up 4
Copper	36.00	27.00	down 19
Magnesium	35.25	35.25	none*
Nickel	64.50**	74.00	up 15

* Last change: Aug '56
** Dec '56

briefs . . .

Big cost reductions on titanium parts are being achieved through a new production technique, Curtiss-Wright reports. By extruding Ti parts directly from cast ingots, instead of using the much more expensive forged billets as starting point, C-W's Metals Processing and Wright Aeronautical Divisions have been able to save as much as 40%.

Zirconium prices are down to barely a third of their 1953 level, Carborundum Metals Company proudly notes. Reactor-grade sponge is $7.50 a lb; commercial grade, $5 in 1000-lb lots.

Aluminum-tin bearing alloy, developed by Britain's Tin Research Institute, is now serving as a coating for steel bearings where, the Institute says, it offers several advantages over copper-lead types. Among them, lower cost and a good compromise "between the opposing demands of high fatigue strength and low wear rate." Composition of the alloy is 20% tin; 1 to 3% copper balance, aluminum.

For best weather resistance, use acid-resistant porcelain enamels, the National Bureau of Standards recommends. Long-term exposure tests under four different climatic conditions showed that enamels able to meet Class A or AA specifications in the citric acid spot test are far superior in color and gloss-retention to any of the other common types.

High-purity tantalum for electrical capacitors and nuclear energy applications is coming from a new source: Kennametal, Inc., Latrobe, Penna. It's ready to supply 99.9% metal in bar, sheet, wire, foil, and granules; says the high-purity material not only has good electrical properties, but also exceptional resistance to acids.

Neoprene is 25 this year, and as the first synthetic rubber to reach commercial production in this country, it claims the distinction of kicking off what is now a billion-dollar industry. DuPont, neoprene's producer is proudly introducing a new 50-million-pound plant, and points out that price has come down steadily as production rose–from an initial $1.05 per pound to the present 39¢. Meanwhile, uses have expanded to include every thing from adhesives to shaft seals for electric motors.

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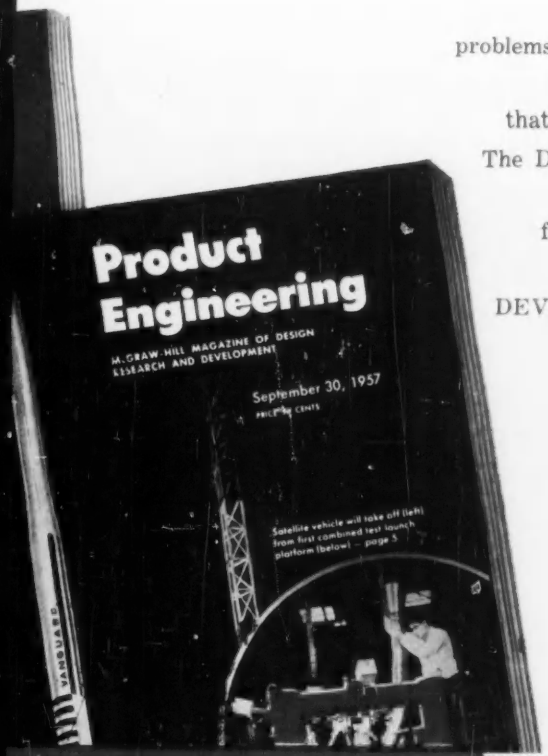

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Fastener Facts

by Henry Peterson, Chief Engineer — Judson L. Thomson Mfg. Co.

DESIGN PRODUCTION & PURCHASING DATA

USE OF BIFURCATED (SPLIT) RIVETS

Self-Piercing Fasteners

You specify bifurcated (split) rivets when you want self-piercing, permanent fasteners for high-speed assembly of light metals (up to 0.040" thick), wood, fibre, leather, canvas and plastics.

Slots milled in the bodies of cold-headed solid rivets form two prongs that have the inherent strength of forgings.

Advantages of Use:

With bifurcated rivets, you not only eliminate the delay and cost of pre-punching or pre-drilling holes, but also avoid weakening assemblies through removal of material. Applied by high-speed automatic rivet-setting machines, which can be operated by unskilled help, they reduce assembly time and costs to a minimum.

When you specify Thomson Bifurcated Rivets, you make sure of the fastest possible solution to your fastening problem and earliest possible delivery of test samples and production quantities.

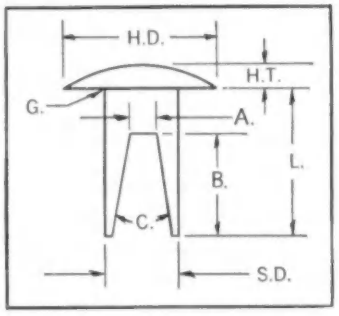
As the first patent holder on bifurcated rivets, Thomson has the longest experience in applying them. Since 1885, thousands of standards have been developed for manufacturers of canvas bags, dog collars and harnesses, golf bags and shoes, hand bags, leather goods, luggage, raincoats, sheet metal products and assemblies, sporting goods, tote boxes, and other products. So your chances of solving special problems with standard bifurcated rivets are best when you call on Thomson.

DIMENSIONAL DATA:

Head Diameter (H.D.) ranges between 1.75 and 2.75 times shank diameter for rivets produced by single-die heading machines. Larger diameters are available at higher cost.

Head Thickness (H.T.) ranges from 0.3 to 0.6 times shank diameter depending on head shape: oval, flat countersunk, ideal, flat, countersunk with bevel on bottom.

Shank Diameter (S.D.) ranges from .040" to .330" for standard sizes.

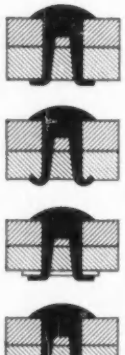


Slot Width (A.), Slot Depth (B.) and **Slot Angle (C.)** vary with each application, depending on thickness and hardness of materials and strength requirements of the clinch. Tests on actual samples are recommended in most cases.

Rivet Length (L.) ranges from 0.6 to 6 times shank diameter. Exact length is generally determined by adding shank diameter to assembly thickness.

Radius (G.) at corners ranges from .005" for ¼" rivets to .015" for 2" rivets.

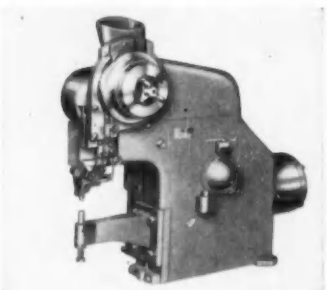
Four Types of Clinch:



Thomson Bifurcated Rivets are clinched by anvils that spread the prongs flush with the surface, turn their prongs into material, against burrs (washers) or inside caps. The latter two methods are specified when a stronger bearing surface is required. The use of caps improves assembly appearance by giving uniform appearance to both ends of the rivets. Washers and caps are applied by multiple-feed automatic rivet-setting machines. The use of caps, calls for perfectly symmetrical rivets so that neither prong will miss the cap. Thomson guards against such misses by precision manufacturing, statistical quality control, 100% final inspection and factory tests on actual samples.

High-Speed Rivet-Setting Machines

Whatever your fastening job, the chances are that one of Thomson's more than 200 standard rivet-setting machines can be quickly and easily adapted to fit your needs. Models include combination rivet and cap-setting in both bench- and floor-types with 5" throat depth. Automatic hopper feed, multiple rivet-setting heads and special work-handling and loading devices are accessories that speed up assembly. Thomson helps you select the proper machine for your job, custom-tools it to meet your requirements and factory-tests it on actual samples before shipment. Available on a sale or lease basis.



MOTOR-OPERATED BENCH MACHINE

Design and Engineering Service

Save time and money by asking Thomson Engineers to study your fastening problems before you designs are frozen. This service, performed at your request, promises the speediest delivery of the right rivets and machines for you. Send sketches, prints, or actual samples of recommendations and quotations.

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This new Thomson manual is compulsory reading for anybody who specifies or buys fasteners. It covers everything you need to know to take advantage of the economy and speed of rivets and rivet-setting machines: rivet types, applications, material finishes and other vital factors.

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. . . with a sense of URGENCY

A young PhD, sponsored by the Ford Foundation, recently studied scientists and engineers on the Ohio State campus. He was mystified by the finding that there is no essential difference between physicists, chemists, metallurgical engineers, electrical engineers, and mechanical engineers working in allied fields. All are concerned with fundamental problems, expanding the frontiers of knowledge, tackling the problems through a scientific approach.

Says Dean Gordon B. Carson, "Engineers are just scientists with a sense of urgency."

It is important to remember this difference that is no difference, because it helps to explain why the ideas discovered in one field are likely to become developments in another.

Research, as Robert Greenlee, consultant at Battelle, said recently, is like tossing a pebble into a pond. Every pebble of accomplishment causes ripples that radiate outward to affect all other scientific efforts. For science and engineering are a continuous medium, like water, and the ripples of accomplishment cross the disciplines as if they were not there.

An alloy developed at Battelle for watch mainsprings was used by surgeons at Wayne University to repair a valve in a human heart. Another alloy, vitallium, developed for false teeth, became a jet-turbine bucket material. Ultrasonics, first applied to cutting teeth, now inspects, cleans, cuts metal. Milk, once only a food, now is the base for adhesives, paints and other products. And so it goes, for numberless other materials, processes and ideas.

Thus the ripples of development grow into a wave of technological advance that overwhelms the old and outdated, even in remote disciplines. And, in a smaller way, it affects all industries and even all plants. Automation in big business forces some automation in small, farm mechanization influences city population. The automobile affects railroads, cities, industries, people's lives.

This situation makes it increasingly important for anyone in engineering to watch the ripples. Only in that way can he be ready to ride the wave of development when it comes.

Spurgeon Automation Unit on the test floor of the Spurgeon Company at Van Dyke, Mich. Note the vital points where Clevelands are installed—a small unit (20AT) driving the feed mechanism and two 70ND units, one at each end of the elevator lift.

Spurgeon automation unit employs three CLEVELANDS

IN a Detroit automotive plant, three Spurgeon units automatically elevate, transfer and feed steel bars into bar cut-off machines. Top production is gained and hours of man power and money are saved by automation.

Three Cleveland Worm Gear Speed Reducers are employed on each Spurgeon unit: Two vertical reducers on the mechanical drive that operates the elevator; a third Cleveland on the "V" Roll Conveyor pushes the rods into the bar cut-off machine.

Automation and Cleveland Worm Gear Speed Reducers go hand-in-hand. Precision matching of case-hardened steel worms to nickel-bronze gears insures 100% dependability. And, the compact, right-angle Cleveland design saves space and makes installation easy.

Find out what Cleveland can do for your operations before you buy. Catalog 400 gives the story. The Cleveland Worm and Gear Co., 3279 E. 80th St., Cleveland 4, O.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

Design for Limited Warfare

NEW YORK—American industry is designing and producing a galaxy of fast, lightweight vehicles and ordnance that pack a powerful punch. This is the armed forces' hardware expected to give the U S speed and effectiveness in quenching trouble anywhere in the world.

Mobility is the basic requirement for the weapons in a localized war. And mobility has been designed into the tanks and artillery that will move in the vanguard of our troops. Typical weapons are:

Scorpion, M-56, 90-mm self-propelled gun that can be dropped from the air. The tank body built entirely of light metals has an 80-in. high silhouette; weighs 7.5 tons. Power is supplied by a 6-cylinder, air-cooled, 205-hp continental engine with cross-drive transmission. Max speed: 30 mph; range 140 mi. The M-56 is designed to cross trenches 48 in wide and climb vertical obstacles 30 in high. Cadillac Div. of GM will produce it.

Reconnaissance tank T-92, is armed with a 76-mm high velocity gun mounted in a cleft turret. Machine guns of .30 and .50 caliber are mounted at side turrets. The tank weighs 18 tons, 7 less than its predecessor, the Walker Bulldog, yet it is 3 ft longer. The project is still under development at Aircraft Armament Inc., Baltimore, and is planned as the predecessor to a full family of lightweight tanks. It features several firsts in lightweight tanks: semiautomatic gun loaders, automatic cartridge ejector, a new method of engine cooling and superior vision and escape routes.

T-113 armored carrier is amphibious and air-droppable. It can be used as a launcher, weapon carrier or mobile command post. Food Machinery and Chemical Corp. is still doing early development work.

Mechanical Mine Planter lays an antitank minefield automatically. The mines are armed and planted at a predetermined rate. Only a tractor operator is required. Mechanized minelaying is faster and safter than the old method, which required holes dug by hand for each mine.

ONTOS antitank weapon packs six 106-mm recoilless rifles, four spotting rifles and a .30-calibre machine gun into 8.5 tons over-all. Allis Chalmers is the major manufacturer.

Vulcan 20-mm, T-171 rapid-fire cannon, in production at GE, is used now on supersonic fighter planes. The gun has a rotating cluster of six barrels, an external power source, and electric drive. Its design is based on the 84-yr-old gatling gun.

M-60 lightweight general-purpose 7.62-mm machine gun will replace all three present Army .30-caliber machine guns. It can be fired from the shoulder, hip, a bipod, or newly-designed aluminum tripod mount. It is chambered for the standard NATO cartridge. Two major contractors are GM's Inland Div. and Bridge, Tool & Die Works.

J-14 rifle, replacing the famed M-1 Garand, the carbine, the Browning automatic rifle, and the submachine gun, is equipped with either a light (M-14) or heavy (M-14) barrel. It fires fully or semiautomatically using standard 7.62 NATO cartridges. The J-14 weighs 8.7 lb.

T-18, a 30-mm automatic revolver-type gun, is in development by GM's Oldsmobile and Ford Motor.

T-45, 177-mm, is newest and one of the most versatile pieces of field artillery. In many respects its capabilities are superior to the combined features of the 155-mm gun, the 8-in. howitzer and the 8-in. gun. It can fire a complete circle and occupies its firing position quickly with no need to dig recoil or spade pits. The T-45 operates on hydraulic-electric power (never before used on towed carriages with the exception of the 280-mm atomic cannon) to reduce the work of the gun crew and speed firing.

Movement of men and materials in the air is a vital aspect of mobility, and it is initiating some radically new aircraft concepts.

AIRCRAFT

Aerocycle adds wings to the infantryman. A pilot perched on a platform over the rotor blades can guide the 200-lb vehicle by leaning in the direction he wants to travel. The aerocycle flies at an estimated 65 mph, has a 150-mi range. It is powered by a 2-cycle Mercury outboard rated at 44 hp. Delackner Heliocopter is the developer.

Pawnee, also under development as a multi-engine "flying platform" by Hiller. It will operate on the ducted-fan principle and be powered by three 44-hp 2-cycle engines.

Aerial jeep, also to operate on the ducted-fan principle, is a potential replacement for surface vehicles in army combat units. It is a vertical takeoff and landing vehicle.

STOL-VTOL (Short and Vertical Take Off and Landing) aircraft now under development will be able to operate in areas lacking good airstrips, but will have speed and other advantages of fixed-wing designs. The craft operate on high-lift principles and have lightweight gas turbines. Other aircraft developments include

T92 Light Tank

One-man Helicopter

H-40 Turboshaft Helicopter

Mechanical Mine Layer

M-56, 90-mm Self-propelled Gun

Hawk Missile

Aerial Jeep

Long-range Camera

Tilt-wing VTOL Aircraft

convertiplanes as well as inflatoplanes.

H-40 Heliocopter, developed by Bell Aircraft, weighs 56 lb, carries a payload of 1000 lb. Powered by a Lycoming T-53 gas turbine, it has a range of 180 mi and max speed of 132 knots. The craft can hover at a 19,000 ft ceiling.

Nuclear aircraft holding the promise of long-range flight without refueling may be used for transports. Nuclear transports would enormously reduce overseas fuel storage. Studies indicate the development is feasible. No radical new designs are necessary.

MISSILES

Missiles will play a role in "brushfire" wars. The Department of Defense lumps in this category any projectile with a range up to 1000 mi. These weapons add potency to the firepower backing the troops in a limited war. Designed to strike a target with accuracy, they give the services destructive power over a wide range and depth of battle area without exposing manpower.

SURFACE-TO-SURFACE

Corporal—This 40-ft long, 12,000-lb ballistic missile is operational. It fires a nuclear warhead over 75 mi, about six times range of the atomic cannon. The Corporal is guided by a command radar system.

Sergeant—Successor to 4-yr-old Corporal but still in development at Redstone Arsenal. Designed to be more mobile, with solid rather than liquid fuel. More precise guidance, and invulnerable to electronic jamming, but less range than the Corporal.

Redstone—Army missile in production, but not operational. Has range of 175 mi. Nuclear warhead separates from rocket vehicle. Is guided by inertial guidance system until separation of warhead.

LaCrosse—In production but not yet operational. Battlefield missile with range of about 8 mi. Is used for close combat artillery support. Can be launched from a standard truck.

Dart—An Army missile also in production, but not yet operational. An antitank, solid propellant rocket designed for front-line troops. Has a 2-mi range, and wire optical guidance.

Honest John—Operational with a battlefield range of 20 mi. This Army missile can carry a nuclear warheard. Smaller, more mobile version, Little John, now in production.

Adequate 'Brush-fire' R&D Expensive

WASHINGTON—A battle for funds is brewing between Pentagon officials pressing for design of limited-war weapons and equipment, and cost-conscious administrators and legislators who prefer virtual dependence on development of intercontinental missiles for massive retaliation.

Those who believe future wars will be "brushfire" conflicts are convinced that weapons for massive retaliation will be prohibitive by common consent. Just as vigorously, others argue that the US is behind in missile development, and that our design engineering effort (which takes most of the budget money) should be keyed to catching up.

Aside from the budgetary pros and cons accompanying this policy squabble is the far more fundamental question: can the US and Russia agree to confine future wars to limited patches of the globe? Can weapons that wreak total destruction be restricted?

Last week, Premier Bulganin, in a letter to Pres. Eisenhower, expressed doubt that warfare can be anything less than total in this day and age. This attitude dismays many who, while conceding that wars cannot be eliminated, are hopeful that global conflict won't materialize.

As it stands, the Army will spend about $725 million during fiscal 1958 for production of light planes, combat and support vehicles, artillery, weapons, ammunition, and other arms (excluding guided missiles). The Army will spend roughly $200 million for R&D of new nonmissile equipment.

These are reductions from last year's spending. The outlook is for further slashes in fiscal 1959 as the Administration puts heavier emphasis on production of weapons for all-out nuclear war. Administrators say the US now has sufficient military strength—2.6 million men in the Army, 200,000 Marines—to handle ground fighting of limited war.

Against the backdrop of policy squabbling and budget restrictions however, the services are building up an arsenal of advanced weapons (see story opposite) to fight the so-called brushfire wars. The tight budget, however, has restricted design efforts and subsequent production rates.

Army strategists want units in localized actions to be mobile, to have fast and interference-proof communications, and to have effective and accurate firepower.

By the same token, the outcome of any conflict will hang on keeping sea lanes open for transporting men and materials. This is the Navy's purview. Vessels are to be equipped to deliver a gamut of weapons from thermo-nuclear through the small atomics and TNT.

The Marine Corps, whose units are currently deployed in the US, in ships and bases all over the world, is equipped to establish land bases in the event of conflict. Current Leatherneck objective is to be able to strike rapidly into inland areas. Direct assaults on beaches is of decreasing importance. The helicopter is the trump card here, carrying assault forces from ships at sea to shore bases in spite of tides or adequacy of beaches.

Air Force strategy is to maintain at all times a strong deterrent force completely independent of any localized conflicts. For brushfire actions the AF will use the Composite Air Strike Force—a unit of the 19th Air Force—based in the US. It is tailored in composition, size and capability to meet the needs of localized actions.

Regulus—Navy missile fired from ships and surfaced subs against ships and land targets. Launched by two solid-propellant rockets and powered in flight by a GE J-79 jet. Supersonic, it has a range of better than 1000 mi. Now in production.

SURFACE TO AIR

Hawk—An Army missile now in production, but not yet operational. Used for field defense against low-flying planes. Has a 15-mi range with solid-propellant fuel. Will be used by Marines.

Terrier—Navy, ship-launched anti-aircraft missile with 10-mi range. Launched by solid-propellant rocket, then powered by liquid-fueled rocket. New version with Sperry beam-rider system has double the range. A land-based model is used by the Marines. Tartar, a smaller version for use on destroyers, has 20-mi range. Not yet operational.

Bomarc—Air Force missile in production, but not yet operational. Range of 250 mi. Launched by liquid-propellant rocket, then powered by two ram-jets. (Latest reports say the Bomarc missile has top priority for adaptation to an antimissile missile.)

Talos—Army-Navy missile in production, but not yet operational. Range: 35 mi. Two models for either shipboard or land launching. Solid-fueled rocket booster with selfcontained ramjet. Has beam-ride guidance that switches to semiactive homing system for attack.

Bullpup—Navy missile in production but not yet operational. Has 3-mi range and is used for aerial attack on small targets: tanks, pill-boxes, truck convoys and bridges.

Sparrow—Navy rocket operational with a 5-8-mi range. New version, Sparrow III with radar homing system, now in production.

Falcon—An operational air-to-air missile with 5-to-10 mile range has a heat-seeking infrared guidance system. About 6 ft. long.

Testing for Tomorrow's Army

SAN FRANCISCO—A vanguard of behind-the-scenes scientists and soldiers is shaping tomorrow's army in terms of greater mobility, and more efficient use of manpower and firepower. They will make recommendations by 1960 for a general reorganization of the present army into an army of the future in 1962.

For 14 months these men have been pioneering at Fort Ord's Combat Development Experimental Center, which operates as a field lab to develop combat techniques and equipment. CDED is a combination of military experimental group, scientific advisory group, and some 3000 troops. In 1957 its 49 officers and 20 scientists administered a budget of $5 million.

Besides conducting experiments in tactics and techniques using materials now or soon to be available, the men at CDED expect to develop weapons and equipment to meet demands of new tactical concepts.

One of the first developments was the Center's "umpire" system for evaluating experiments. A control center has been set up in an 80 x 40 x 20-ft "air house" of nylon-like material held up by air pressure. This control system permits constant tracking of each weapon and piece of equipment. Control boards showing this information are photographed at intervals so that after any experimental run there can be a playback that allows the whole experiment to be run over again without putting troops in the field.

For instance, in a war exercise, if soldiers in Squad A fire rifles at aggressors in Squad B, within 15 to 30 sec after the weapons are fired, Squad B knows it's under fire and the data recorders know the casualties. The men at CDED expect to speed up this control as their work continues.

The data recording and analysis equipment uses punched-card and magnetic-tape equipment; a Decca-Bendix system may be introduced.

One of the ingenious devices developed to aid umpiring is a gun camera that was used in aircraft-vulnerability studies to find out what ground fire could do. Pictures taken as the guns were "fired" showed how accurate the marksmanship was, how much damage would have occurred.

Also developed was a columnated light for use in tank guns coaxial with the tube. Firing of blanks actuates a light seen only in the actual radius of the burst of fire. Tank fire had been particularly hard to umpire.

Scientists at CDED presently are working with Raytheon to develop an umpire system that will use infrared light. Instead of mounting guns they will mount infrared units that will emit a small-diameter beam. This beam will actuate infrared sensitive areas to show casualties—by popping up a flag on a helmet or activating a solenoid system that would put a gun camera out of commission.

Experiments that have been completed or will be completed during this fiscal year include, besides the umpire techniques:

1. Vulnerability of low-flying fixed-wing and rotary aircraft. Experiments showed what casualties could be expected at varying altitudes with varying formations under varying conditions of light, weather and terrain. The gun camera resulted from this work.

2. New-type antipersonnel mine, representing one of a series coming into production.

3. Use of 3.5-in. rocket launcher in antitank warfare. Concepts of future warfare increase need for a light, small-unit antitank weapon.

4. Use of mobile basic weapon or self-sufficient crews. Such groupings combine under command of one man, capabilities in combat surveillance, direct fire, indirect fire, and small arms. With increases in weapon power and improved communication and control, considerably fewer men should be able to do tasks presently requiring large numbers.

The CDEC staff, which has worked with the Willys mechanical mule and a Food Machinery & Chemical Corp. personnel carrier, will be working with the T44 7.62-mm rifle, developed as part of the NATO program for standardizing weapons (Sept. 23, p. 38). Belt and helmet radio is another project.

A major problem is mobility of forces—(World War II Infantry fought on fronts 1600 yards wide, in atomic war a front may be 16,000 yds). A problem of this type involves surveillance, controllability, artillery support, and field test of weapons.

Plan For Aid-to-Science-Education

WASHINGTON—The post-Sputnik race to raise scientists to a status sublime has flowered a barrage of proposals to spur US scientific education.

Programs are cropping up so rapidly that Washington observers slyly suggest that next month's roll will consist of having members respond with their aid-to-education plan. Probable result: any student who wants to take up the sciences, or advance his scientific education will have government assistance readily available.

Here are some of the proposals in the mill:

- Navy has already announced that it will start 500 enlisted men per year on four-year scientific educational programs, then commission them as officers after they have received their college degrees. It will be something like Navy's present ROTC program.
- The administration reportedly is working on a program that would pump some $200-million a year into boosting scientific education through scholarships, higher pay for teachers, financial assistance to schools to enable them to expand their curriculum, and similar programs.
- A more ambitious program is being sponsored by Senator Lister Hill (D-Ala). It calls for spending around $500-million a year in much the same way, but on a larger scale.
- A new cabinet post of secretary for science has been proposed by Sen. Hubert Humphrey (D-Minn.), along with bills to aid students meet the cost of a scientific education.

And, there are more such programs brewing. One thing sure: more money will be pumped into the nation's educational programs.

Electrical Insulators Demur on Grouping

NEW YORK—A group of 100 manufacturers met here recently and agreed to form an organization for the purpose of disseminating practical information about the properties and uses of electrical insulating materials. The name of the organization will be the Electrical Materials Association.

However, when it came time to take a vote on these three questions: (1) Do you favor a formal organization of the EIMA as proposed?; (2) do you favor cancelling EIMA plans? (3) do you favor maintaining an EIMA committee until March 31, 1958?; the membership appeared to favor waiting until next March to formalize.

Those in attendance agreed on the need for such an organization which would serve to benefit all users of basic electrical insulating materials, but the vote of the three questions was tallied 14 ballots for (1), 3 for (2) and an overwhelming 47 for (3).

BITS AND PIECES

Scientists involved in the Windscale Reactor accident at Britain's plutonium factory will protest to the Government about "monstrous inaccuracies" in the official report. Stating they have been "pilloried as scapegoats," they maintain among other serious allegations: that the pile physicist accused of initiating the disaster due to error of judgment was not even present during the incident; the cause was not properly accounted for and the public misled; the committee, including Sir William Penny, did not know enough about uranium reactors to determine the cause; and that scientists are denied access to the unabridged version of Penny's report.

Rising Sun Jet

Japan's first domestically-produced jet aircraft—a prototype medium jet trainer—has been unveiled at the Utsunomiya plant of Fuji Heavy Industries Company. The plane, T1F2 is the first of three ordered on a 370 million yen contract. Mass production may start in 1959. The jet is 40 ft long, 12.5 ft high, and has a wing span of 24.4 ft. Carrying a crew of two, the plane hits a top speed of Mach 0.85 and altitude of 40,000 ft.

As we were saying . . .

last week in our roundup on translation by machine, p. 85, Russia is already using electronic translating machines. This week comes alleged confirmation from the Russian Embassy in Bonn, via McGraw-Hill World News. The "Strela" computer in the Russian photo performs 2500 calculating operations per sec and is capable of language translation. But the Russians don't explain how language-digestion problems have been solved.

Electronic Message-switching Speeds Air Force Communications

CHATTANOOGA–A new high-speed electronic private-wire system enabling Air Force personnel to contact bases anywhere in the world in a matter of minutes has been developed by Western Union Telegraph Co.

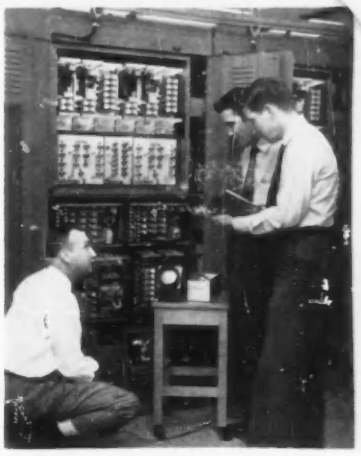
The fully automatic message-switching system, known as Plan 55, is slated for full operation by the end of 1958. Capacity will exceed 2.5 billion words annually, or three times more than handled immediately following World War II. The new system will require only 480 operators, compared with 1,300 formerly required for one-third the load, releasing 1.7 million Air Force manhours annually for other military duty.

Designed to replace earlier semi-automatic tape-relay equipment that sometimes took hours to process communications, the Plan-55 system types a message only once and flashes it automatically to world-wide receiver points. An electronic memory automatically checks the number sequence for operator failure and equipment or line failure.

It also determines message priority, routes priority messages ahead of routine traffic, and checks message destination to prevent misrouting. At the same time it sets up the necessary circuits for relay transmission. Tape that has been read electronically for routing and priority is then automatically shifted to the proper outgoing circuits by a sliding-latch transmitter.

The system is prepared to cope with the possibility that radio circuits employed in the overseas part of the network may fade. It can signal this condition, alert the transmission supervisor when human intelligence must be applied at the transmission center to monitor such reception and take necessary action. With the flip of a switch, the "distress" position becomes a semiautomatic forwarding operation with push-button circuit selection.

When a single message is destined for two or more recipients, the new equipment automatically distributes the communication, selecting the degree of message priority in the process. Also, additional message-traffic volume can be handled readily by interconnecting more equipment units and circuits as required. In addition, the system is completely mobile. If necessary, an entire switching center can be disassembled quickly by sections, loaded on aircraft, flown across country, and put in service at another location on short notice.

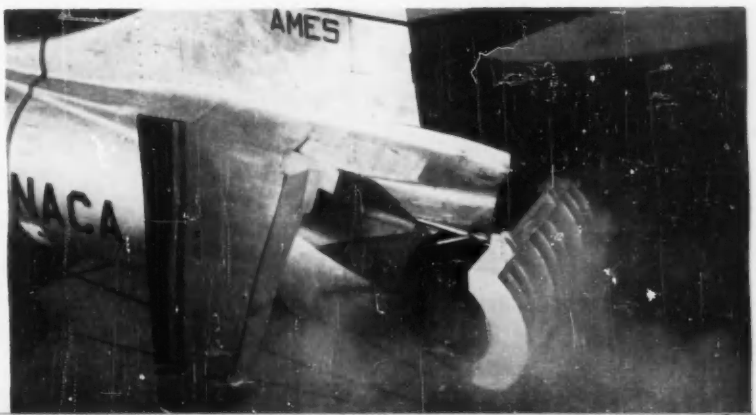


Master message center . . . destined for Air Force's globe-girding communications system, gets last check at Western Union's Chattanooga plant. Final test runs of electronic message-switching equipment simulates operating conditions, help familiarize Air Force personnel (above) with every phase of maintenance.

"Clamshell" Gives Jets Powerful Braking Action

MOFFETT FIELD, CALIF.–The first practical demonstration of a jet-engine device that reverses thrust and provides instantaneous control of thrust in the air and on the ground was completed here by pilots of the National Advisory Committee for Aeronautics' Ames Aeronautical Lab. Most important use of the device is to give jet pilots precision control over their approach glide path and touchdown point. Also, the reverser is useful in braking the landing roll of a jet plane after its wheels are on the runway. In this application, it is used like the reversible propellers on modern reciprocating-engine transport aircraft.

In design, NACA's reverser is an adjustable metal clamshell mounted on the engine's tailpipe. In open position, the device allows hot gases from the engine to follow their normal path and deliver a maximum forward thrust, in this installation 6,000 lb. When fully closed, the two halves of the clamshell form a semicylindrical barrier against which the jet exhaust impinges. Thus, thrust is partially reversed so engine, at full throttle, delivers 3600 lb thrust in the reverse, or braking, direction. The device is unusual in that the pilot can vary almost instantaneously the amount of forward or reverse thrust desired in the landing approach by changing the "clamshell" setting through a hydraulic control. Not intended as a production device, the reverser is being studied in extension of investigations conducted at NACA's Cleveland laboratory two years ago.



Italy to Host First Machine-tool Fair

MILAN—This nation's first machine-tool exhibition is scheduled for September 1958 at the Milan fair grounds under the auspices of the Association for Italian Machine-tool Builders. Both Italian machine-tool makers and foreign firms represented in Italy will participate in the 10-day show.

To date about 110,000 sq ft have been assigned—82,000 sq ft for manufacturers, the remainder for representatives and agents. Supporting the exhibition are associations of machine-tool tradesmen, precision optics, mechanical-tools and foundry-machine builders. It is hoped the Milan show will develop into an every-other-year exhibition alternating with the European machine-tool fair.

Navy Mercury Lamps Brighter by the Dozen

JOHNSVILLE, PENNA. – Twelve tiny lamps, each smaller than a king-size cigarette and grouped to emit a light source equal to 36 million candlepower, have been developed by the Naval Aid Development and Materiel Center. Development came in conjunction with experiments in night aerial photography.

The lamp unit was tested recently in a Navy PT2V Neptune patrol bomber flying at 20,000 ft. The unit of small quartz tubes, each 4-in. long and ¼-in. dia, was housed in special reflectors.

Tests showed it was capable of providing enough illumination at night to cover 16 sq mi, enabling someone on the ground to read a newspaper easily.

Russians Work on Automated Steel Plants

LONDON—Latest reports are that the Russians are working on completely automated plants in the steel-making industry. There are two approaches to the plan: charge the blast furnace and remove the slag on one side of the furnace, and produce steel ingots on the other; use pig iron as the initial product with a stream of pig iron coming into a continuous unit, the iron being decarburized by oxygen.

Aluminum Hopes to Gain Weight in Each US Car—260 lb More

DETROIT—The aluminum industry has set its sights on packing 300 lb of the light metal into each automobile. But they realize this goal is a long way off. Cars this year use 40 lb of aluminum; 10 years ago they used 12 lb.

Industry spokesmen base their rosy hopes on a combination of consumer demand and aluminum's physical properties. Americans want big cars. But booming sales of foreign imports indicate they also want economy. Aluminum cars, it is claimed, could match today's models in speed, acceleration and climbing power. Being lighter, they would require less power, less gas.

Eventually aluminum parts can probably be made as cheaply as their steel counterparts. Per-pound cost of aluminum exceeds that of steel, but a pound goes farther. And production methods, especially die casting, permanant mold casting, stamping, extruding and impact extruding are low cost. Aluminum parts can be cast so close to final dimensions that little finishing machinery is required. And the machining that must be done can be carried out very rapidly—at about wood-working speeds.

Physical properties, too, make aluminum particularly suitable for design improvements; for instance, lighter parts can reduce front-axle load. Aluminum's heat conductivity makes air cooled engines possible. And aluminum has good electrical conductivity, suggesting applications in the electrical system.

Assault with Ideas

The metal's prophets are making a broad assault on Detroit. They are working hard to re-educate engineers reared on steel to think of aluminum. Later they will push volume sales. Company representatives, located permanently in Detroit, act as consultants to the auto industry, helping them solve production, design, and cost problems.

Many aluminum-company consultants are recruits from the auto industry with first-hand knowledge of production. They are backed by intensive research and development efforts of the giant aluminum-producing organizations.

In addition to selling Detroit on what they see as inherent engineering advantages of the light metal, some companies are adopting new marketing techniques to increase dollars-and-cents advantage. Reynolds has introduced liquid-aluminum contracts under which they deliver molten metal from their reduction plant to an auto-company foundry for casting. The new technique eliminates two cost-pyramiding steps—ingot casting at the reduction plant, then remelting at the foundry.

The auto industry, for its part, is not stampeding to aluminum. They are switching to it for some parts, and they are eyeing its decorative possibilities. But steel will probably be the staple of the industry for a long time.

Pentagon may Decide

The balance ultimately may be tripped by military demands. The services are seeking weapons they can move fast. That means minimum weight is of maximum importance. Already aluminum-unitized jeep bodies have been built and are undergoing tests. (Oct. 23, '57, p. 87.)

An aluminum engine block may be next. Both liquid-cooled and simple air-cooled models have been developed. The latter can be maintained easily. Adoption of aluminum engines by the armed forces would pave the way for introduction into passenger cars.

Present applications of aluminum in automobiles, while not a stampede, are becoming significant. Aluminum takes a variety of finishes well, making it ideal as a decorative materials for dashboards, inside door panels, and other trim.

Outside, aluminum is used for light bezels and rear ornaments. In the 1958 models, aluminum grilles have appeared on 14 models.

Aluminum may soon appear on rear decks (Detroit lingo for trunk lids) and roofs. Lower silhouettes have brought the roof down to eye range, and designers are seriously considering roofs of decorated aluminum.

The metal is also making inroads on

engineered parts. Though aluminum on bumpers now is strictly decorative, engineers are working on guards of high-strength aluminum alloy bonded to the decorative outside finish. First production runs may come in 1958—certainly in '59.

Nonrusting aluminum may replace copper in radiators. Workable manufacturing processes have been developed and tested. The problem now is to adapt these to present manufacturing equipment.

Wheel drums now are made of aluminum cast around an iron liner. Integral aluminum wheels have been developed and found satisfactory. Again the problem is to develop economical production techniques.

The small hub cap has become a rim-to-rim wheel cover. As it grew, so did the danger of throwing it on a rough road. Lightweight aluminum reduces this hazard, also increases decorative appeal.

When developing automatic transmissions, engineers found their large and intricate housings could be made faster and cheaper with aluminum than with competing metals. Aluminum is firmly established for this use.

The trend to compressing more equipment—now it's air suspension—under a lower car silhouette means rearranging the layout of some parts. The battery, which cannot operate at high under-the-hood temperatures, may be moved to the trunk. A long metal rod made of aluminum extrusions covered with plastic insulator could link it with the engine.

Say US Held Up News of British Research

LONDON—According to reliable source, news of recent British successes in thermonuclear research has been withheld at the request of US authorities. One item held back was confirmation at UK's Harwell Atomic Energy research center that neutrons come from thermonuclear reactions in the discharge tube of the experimental machine Zeta. Soon after Zeta went into full operation in August, Harwell scientists detected neutrons that appeared to result from fusion of individual deuterium atoms.

Zeta was designed to create extremely high temperatures (as high as 5 million C) by electrical discharges in a toroidal tube.

Spying Machine . . .
This "Surveillance drone" representing an unmanned flying-and-spying machine developed for US Army Signal Corps by Republic Aviation Corp's Guided Missiles Div. Republic has a $5 million contract for development and production of this and a more advanced jet version. Model shown is the SD-3. It's an all-weather system, has three different, interchangeable nose units for switching from one "sensing system" to another (photography, radar, or infra-red). Craft can be launched "zero length" (without any 'run') thanks to jet-assisted take-off, and it is recoverable.

New Space, Atom Research Centers

A new company, Data-Control Systems Inc., has thrown its hat in the burgeoning instrumentation industry. Research and development labs and manufacturing facilities will be located in Danbury, Conn. Company operations will cover four aspects of guidance and control—measurement, computation and data handling, telemetry, and control of manned and unmanned aircraft . . . Rensselaer Polytechnic's projected $6 million science center will include underground vaults for atomic research. The program is part of the Institutes goal of providing advanced facilities and techniques for a doubled enrollment. Finished steel shipments for the first ten months have exceeded those for the comparable period last year by 400,000 tons. Total ten month shipments in 1957 have amounted to 69.2 million against 68.8 a year ago. Steel mills were closed by a five-week strike in 1956.

Plan Missile Site

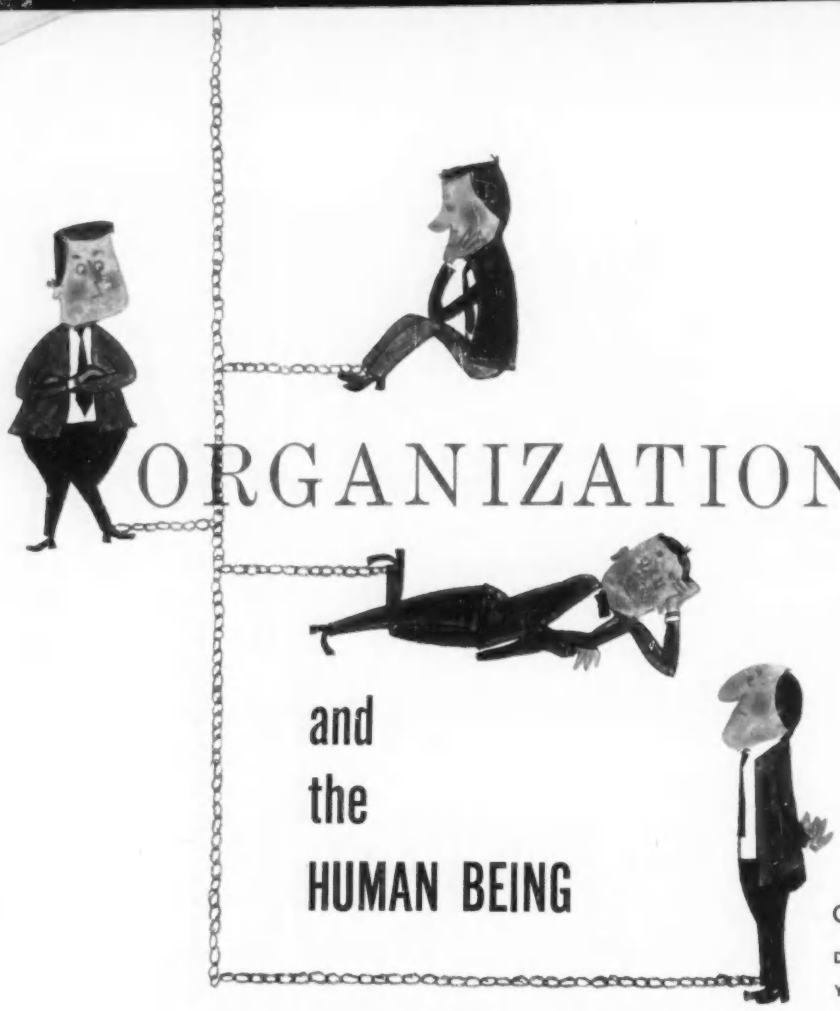
MELBOURNE—A new launching site will be built in Australia during 1958 to test missiles in the 2000-mi range. Estimated cost: $12 million. Plans provide for a later extension of instrumentation and extension of the range. Whether US missiles will be tested at the Down Under site is still uncertain.

Bomber Lead Times Compared

LONDON—Society of British Aircraft Constructors recently compared lead times in building of Boeing B-52 and the Avro Vulcan V-bomber. SBAC notes that US B-52 is a larger aircraft, but asserts that the Vulcan is in some ways more advanced in that it is the first very large delta-wing craft. Society says that from presentation to the manufacturer of the Ministry of Supply specification to start of service in RAF bomber squadrons, time elapsed was 9 yr, 8 mo for Vulcan, compared with 9 yr, 6 mo for B-52. Also, Society reports that 12 million engineering manhours were required on B-52, compared with just under four million manhours on Vulcan from date of original specification to delivery for service.

Japan Clamps Down

TOKYO—Legislation to put stronger teeth into Japan's design law to clamp down on pirating of industrial designs will soon go to the Diet for action. Decision by the Ministry of International Trade and Industry to strengthen law has resulted from protests raised abroad.



ORGANIZATION and the HUMAN BEING

CHRIS ARGYRIS

Department of Industrial Administration

Yale University

Strict adherence to chain of command, unity of direction and the like may destroy creativity. Can you risk the loss?

Organizations are not composed of job titles, they are made up of people—of human beings with human needs, likes and dislikes. Yet the average factory or office employe is asked to do complex and demanding work under controls that seem purposely designed to deny most adult human needs.

Research and development organizations are as guilty as the frustrating factory in Charlie Chaplin's "Modern Times" and possibly with more ominous significance. In recent years, research and development have become team functions. Problems can usually only be solved by experts from many fields working together in a single closely-knit organization. Creativity is essential here, but creativity is intimately bound up with an individual's total personality, his need for self-expression. Yet most R & D organizations today are designed to limit rather than encourage self-expression. Courses in creativity, books, articles, brainstorming and other devices are then used in an effort to bypass normal channels and free the creative functions—and with some success.

Wouldn't a more basic approach be to set up the right kind of organization in the first place? Certainly, if we knew what the right organization was. It is ironic that our finest laboratories, dedicated to the most esoteric research, spend little or no time on how to organize R & D effectively.

A few universities and government laboratories are tackling the problem. Some focus on the impact of a scientist's personality on creative output; others are studying teams of scientists in terms of "small group dynamics." Still others are focussing on the serious problems created by the impact of an organization on its members and their output.

CHARACTER OF AN ADULT

Research to date, in the psychological fields, has some fairly clear ideas about how the child achieves maturity. Psychologically healthy people in our culture tend to change:

- from being passive as a child to being active as an adult
- from depending on parents to relative independence
- from a subordinate position in the family to an equal or higher position than friends and contemporaries

- from having few abilities to having many
- from achieving these changes himself to helping others gain such forms of self-expression.

Parents encourage their children in these changes, and—if successful—youngsters wishing to express themselves, to be creative, need work situations that encourage independence and activity, require many abilities, and offer equal or higher status.

Can the usual organization fulfill these needs? The latest research suggests it cannot.

Formal organizations based on principles of task specialization, unity of direction, chain of command and span of control, that is, organizations that use these principles *correctly*, force their employes into subordinate and passive situations, dependent on a leader for reward, penalty and direction. The degree of passivity, dependence and so forth will increase as we go down the chain of command and as the work approaches mass production.

Therefore, the formal organization places the employe in a situation requiring him to behave more and more like an infant; but, of course, while doing this, he is well paid, given seniority and other benefits.

To the extent that employes are relatively mature adults, they will feel frustrated because they are unable to obtain need-satisfaction while at work. Frustration leads to an increase of aggression and a decrease in individual efficiency.

But this isn't all. It is common in most industries for the organization to hire staff experts who tell the employes how much to produce (production and incentive engineers), the best methods of production (work-study engineers), and the quality they must achieve (quality control and budget experts). The organization places the employe in a work situation where he has little or nothing to say about his goals or the way to achieve them. Researchers tell us this will tend to create feelings of psychological failure on the part of the employes.

People who feel failure lose interest in their work, lower their standards of achievement, lose confidence in themselves, give up quickly, fear new tasks and new methods.

PAID FOR DISSATISFACTION

As a result of the very nature of formal organization, the employes are faced with work situations that create feelings of failure, frustration, conflict, and tension. How do the employes react? They may:

1 Leave. (But where can they go? Most organizations are based on similar principles.)

2 Climb up the ladder. (A few do. It means hard work, loss of friends and isolation.)

3 Create informal work standards to goldbrick, restrict production, make errors, produce waste and most important, become apathetic, disinterested, passive and dependent. (For example, one attitude is "take it easy—don't burn yourself out. The company will be here tomorrow. Relax." Or "What are you trying to do—become president? Relax; let the boys upstairs figure that out. They have to do something in those plush offices. Anyhow, it's their problem not yours.")

4 Decrease their feelings of dependence and subordination to management by taking some of management's power for themselves (Trade unions).

5 Become indifferent to the nonmaterial incentives and human relationships and give greater importance to money and material rewards. (The employe says, "O. K., if you want me to work under these conditions—pay me!" And so management pays more wages, benefits, and so forth. Odd as it may seem, we are entering an era in which a worker is paid more money for his degree of dissatisfaction. This gives us a hint as to why employers may accept autocratic leadership and the dependence and submissiveness that it creates.)

Management's response is not particularly helpful because the true problems have not been understood.

1 Management may say, in effect: "Employes are lazy, apathetic; they are not producing enough." The focus is on the failure of the employe. And management decides, "Very well, if the employes will be apathetic and disinterested we will get hard-driving managers who can really keep them on the ball." Hard-driving, pushing management will increase productivity in the short run, there is little question of that, but it will also increase human costs. It will not develop people, except in the sense that it will make them quite expert in handling the pressure from management.

2 Another attack is through "management controls"—budgets, production bogies, and similar techniques. Consider two department heads: Mr. A, who is loyal and interested in the company, and Mr. B, who believes: "When you get as old as I am, son, nothing will bother you. You just let things ride." Down comes the budget. Both departments are red-circled—they are not meeting the budget. Mr. A gets upset, and tries to do something. Mr. B says: "Oh well, they come down here all the time—never bothers me." What, then, has happened? In effect, these budgets—which were intended to "improve motivation"—act primarily upon the man who was loyal in the first place and make him feel guilty, the second man's apathy is increased.

3 A third approach involves "human-relations programs." One of their major themes might be stated: "Let's all be human, and communicate and participate." An analysis om communications programs, of the newspapers and house organs of 50 of the largest corporations in America, showed that if you ignore personal gossip about who is getting married and who is on vacation, and focus on the message to the employe concerning the plant, 82% of the information has more to do with the anxieties and worries of management than with the employes' problems. Month after month, issue after issue, one reads, on the president's page, "We are all part of the team. We are all loyal employes."

But employes are gentlemen, and as gentlemen they play the game. To the message from above, "We are all part of the team," comes the answer, "Sure, we are all part of the team." To the message from above, "We are all loyal employes," comes the message from below: "Sure, we are all loyal employes." And the sport goes on, and the apathy and disinterest are, if anything, forti-

fied by the absurdity of the game. Clearly, a communications program is a double-bladed sword, and can produce basic conflicts between the worker and management if not used with discretion.

CONFIDENCE

A number of studies of communications programs have been made, and among the interesting results are two which seem especially applicable to management. First, people will believe falsehoods if they have confidence in the persons saying them. Conversely, people will not believe even simple truths if they have no confidence in the speaker.

If you have a basic problem of lack of confidence and you spend thousands of dollars on an internal-communications effort, what guarantee do you have that it is not reinforcing the basic lack of confidence that the employe feels? If you reply that the employe says he likes the house organ, there is, of course, no rebuttal: for the employe is, as I have observed, a gentleman.

There has been a great deal of talk recently about "participation." It started with research comparing democratic and autocratic leadership. Anybody using the results of those studies today, however, is advised to go back to the original experiments. Under a democratic leader people produced more, but the people placed in these experimental situations did not have the authoritarian structure to contend with. They did not have budgets or production bogies, or the like. The results of the experimental situations may therefore not apply too well in industry.

R & D ORGANIZATIONS

The research and development administrator probably has already seen some relationship between these comments and his organization. Their applicability is most clearly seen in the subordinate and nonprofessional jobs involving junior engineers, draftsmen, laboratory technicians, secretaries, maintenance people, who are usually in dependent positions. Also the probability is high that the scientist-boss is a strong leader, thereby compounding the dependence, submissiveness, etc. Strong leadership comes naturally to scientists who long ago decided that their best way to obtain personality satisfaction was to control (or aspire to control) the situation in which they found themselves.

In the case of the average engineer, results are not as clear-cut. The amount of dependence and submissiveness an engineer feels varies tremendously among companies. Some companies define their organization structure and controls to permit freedom. These organizations probably have the greatest creativity and productivity at the least human cost.

Freedom does not mean complete independence. Healthy human beings do not emphasize total freedom as much as they emphasize interrelatedness. Only the anxious person aspires for total freedom, a situation which, if it were possible, would make him even more anxious.

Healthy human beings realize that controls are necessary. In fact they use these controls and restrictive mechanisms constructively: to prevent waste of time and energy (by having adequate and accurate information on the state of a particular project); to facilitate decision-making (by defining clearly the areas where decision-making is possible), to allay anxieties caused by unclear definition of tasks, scope of authority and responsibility, and the like. Constructive and legitimate controls provide the engineer or scientist with a sense of security and clarity.

WHAT TO DO?

We know precious little about creating organization structure and controls that facilitate, indeed, induce, human growth and creativity.

When top-level engineers and scientists are dealt with, patterns of leadership of the administrators are more crucial than the organization structure and controls. High up in the organization, a man usually has power to make changes in the structure and the controls, so they don't trouble him. His boss' leadership usually is the major stumbling block to creativity. What can executives in research and development do about their leadership patterns?

1 Perhaps most important and most strongly backed by research is that executives need to become more aware of themselves—their prejudices, goals and needs. Because, in order to understand others we must first understand ourselves. Please note, I am not suggesting that the executives must change their behavior. A more useful objective is served when executives become more aware and more tolerant of their own makeup.

2 But self-awareness is not enough. An executive needs to develop basic human-relations wisdom—to be able to sense correctly, in every administrative situation, how far the interests of organizational effectiveness will permit individual satisfaction. The executive must become skilled in the art of listening; in asking the questions which will help others understand their own feelings as well as to understand the facts of the situation more clearly; and in accurate observations of behavior.

3 The executive must develop a number of different leadership patterns (directive, permissive and laissez-faire). He should be able to use these individually or in combination, depending upon the situation. The leadership required is not autocratic or participative or consultative leadership. It is **reality** leadership; a leadership that focuses on the realities in any given situation. Although the executive varies in his behavior, the element of uncertainty is not present because subordinates will be able to predict how the executive will respond.

The executive should develop a basic philosophy of life and management. This philosophy should include the proposition that an organization has the right to health as does the individual. It is inhuman to imply to people that they are a crucial factor when, in fact, this is not always the case. Moreover, healthy human beings do not desire to see themselves constantly as the center of focus. They are willing to place themselves in context where their interrelatedness with others gives them an equal share of importance.

Accepting that an organization has a right to health leads to the proposition that if a research organization is to be effective the administrative process must never be second to the research process. A second-class administrative process can never create the climate for first-class research. **end**

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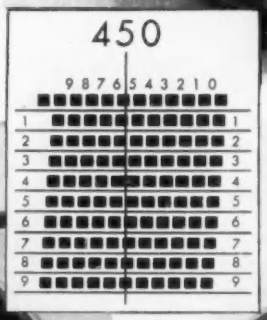
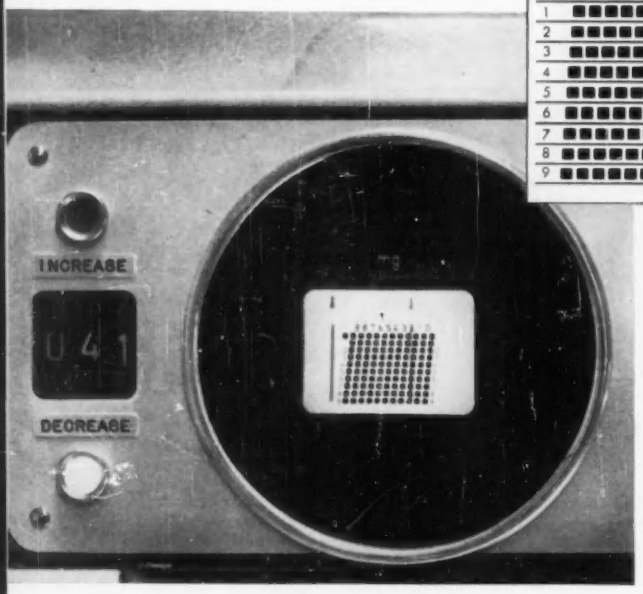
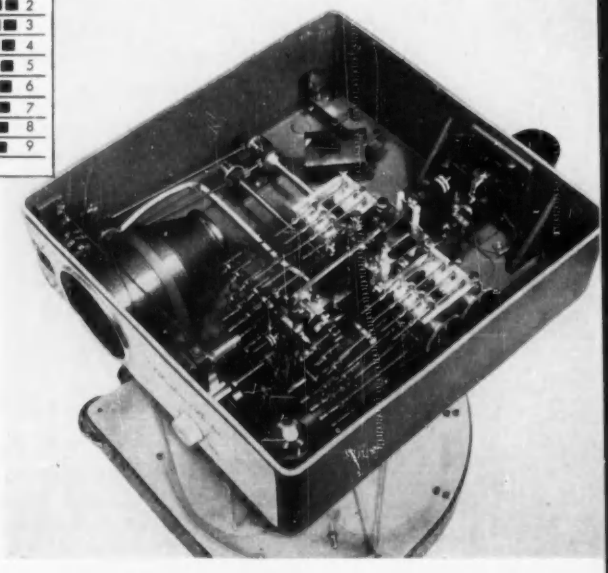
Flat black of the vernier recess reduces glare and eyestrain; the white areas beneath balance pan provide high contrast to objects being weighed. Simplified vernier (sketch below) is displayed in optical readout. Large number at top (450) plus vertical line indicate weight between .455 and .456 gr. Following line down until it fills the gap between blocks gives a reading of .4554 grams. Numerical counter indicates weight to nearest gram. Manufactured by Christian Becker Division of the Torsion Balance Co.







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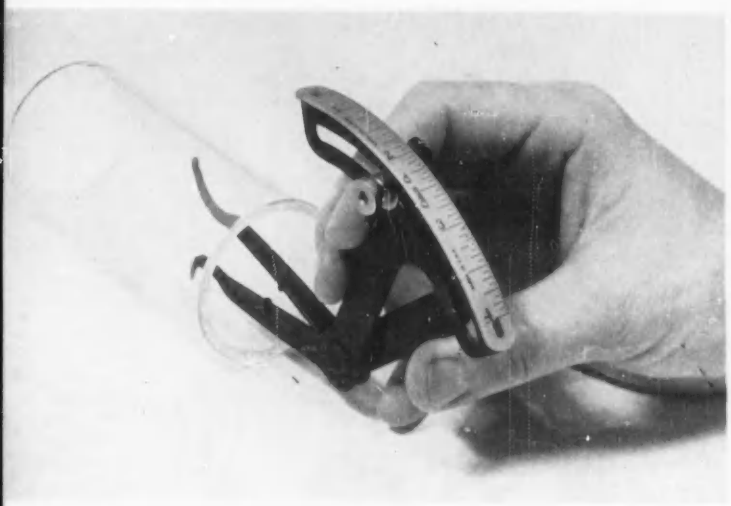
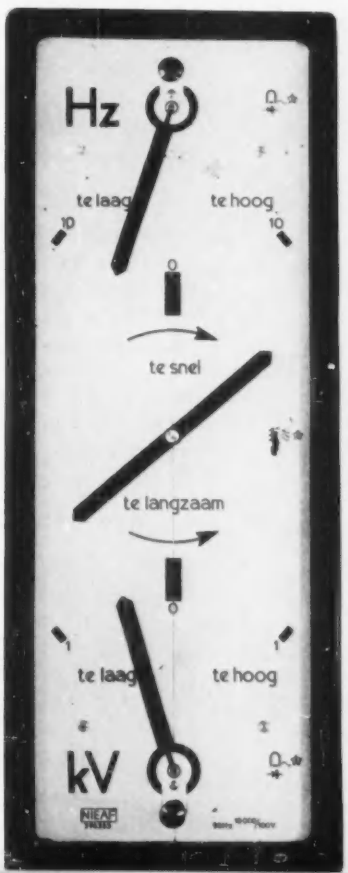
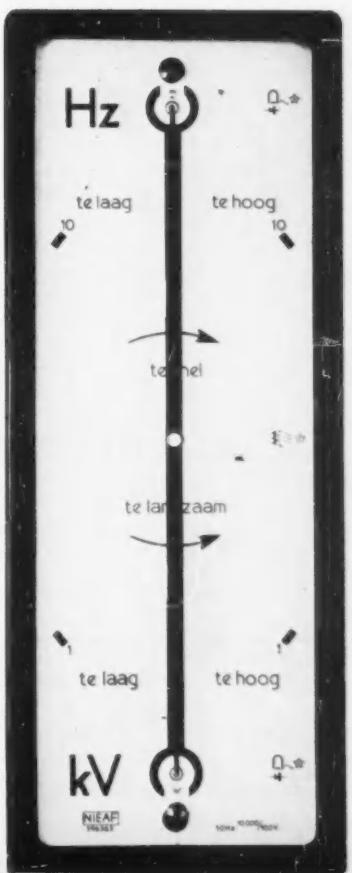
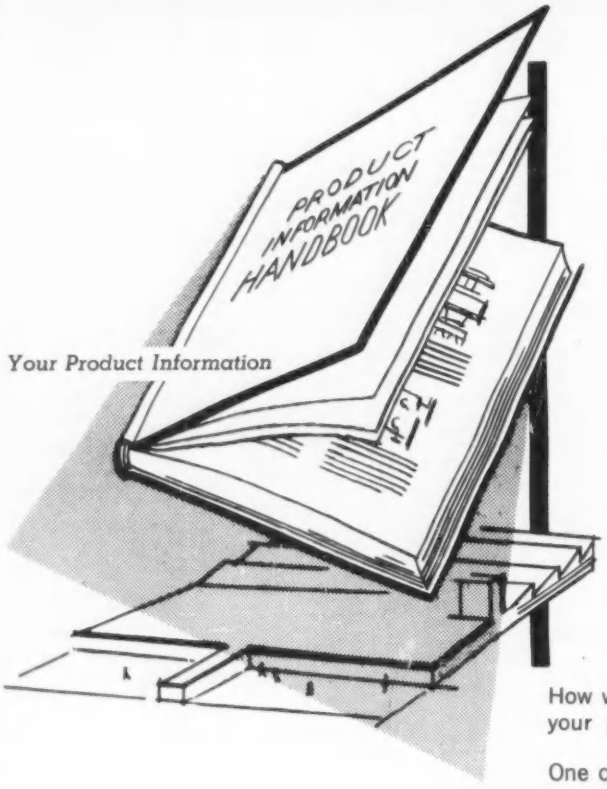


Direct-reading caliper, available in both "inside" and "outside" models, measures 0-to-4-in. dimensions in 32nds. Squeezing handle opens legs, which are closed by a spring. Thumbscrew locks the device at any dimension. Made by Master Specialty Co.

Developed to simplify the joining of three-phase power sources, the combined unit (center) replaces three instruments previously required (left). With power lines properly synchronized, indicator (right) displays a solid bar. This simplified instrument face can be applied to any situation where error-free comparison of two or more changing variables is important. Made by Netherlands Instrument and Electric Apparatus Factory (NIEAF).







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PRETTY—but does it work?

Eye-catching designs are a carefully brewed admixture of engineering and art. Here's the recipe. Just blend, add talent and serve.

RICHARD M. KOFF, Associate Editor

Your latest gearbox redesign came out of Engineering last week and was brought before the executive committee for review. About halfway through the discussion the boss' son (head of advertising) interrupted to say, "I don't know anything about gear design, of course, but wouldn't it look better and take less space if the gear width were reduced, the lubrication system left out, and aluminum used instead of steel?"

As chief engineer you probably exploded—boss' son or not. But wait a minute. How often have you said, "I don't know anything about art, of course, but . . ." and when the artist can't explain why he painted blue trees and a green sky he becomes a dreamy crackpot taking liberties with your intuitive "sense of beauty."

These are typical reactions and as good a reason as any for suggesting that the engineer should stick to engineering and leave the artist to his paint-pots. But in industrial design, the two responsibilities overlap. A good industrial designer is part artist, and part engineer. He may have to make compromises in artistic arrangement to satisfy the demands of the design engineer—or vice versa.

Industrial design takes years of study. Yet the industrial designer is expected to sit by calmly while self-styled experts, having no training or talent, tear his creative effort to shreds. And in appearance design, everyone from the janitor to the president thinks of himself as an expert.

Well it just isn't so. You can't learn much about gearboxes without studying gear design, even if you've examined hundreds. By the same measure, you don't know much about appearance design, even if you've seen and used thousands of products.

"Okay," you say, "I'll leave appearance design to the designer—I couldn't really do it anyway. But must I take his word for everything? After all, my money is being risked—not his."

Here are some questions you can ask yourself and the designer. If the product obviously meets these requirements, or if his answers satisfy you, there will be no further need to question his judgment. If not, get a new designer. Note the important difference: Ask questions—don't say, "Why don't you . . . ?"

Will the product do its job?

This is really an engineering problem, but if appearance design interferes with function—fire the designer, he's a phony. Sometimes appearance can be materially improved by engineering changes. In that case the designer will have thought through his suggested modifications and they will be as good as, if not better than, the previous design.

Can it be operated by people?

Appearance design is of importance only if people will see and use the device. An electron tube or a transformer or a linkage buried in a mass of associated equipment and never touched by human hands won't need appearance design.

But knobs, dials, levers, switches and the boxes they are mounted on will be seen and handled by people. Is this layout convenient? Within reach? Too hard to turn or lift? Fatiguing? Data on human dimensions and abilities have been published—these are the handbooks of appearance designers and the rules must be followed if customers and users are to be pleased.

Here again, sacrifices in ease of operation (and servicing) are never justified when made only for the sake of appearance.

There are many bad examples of poor functional design around us. Note the TV and radio consoles with knobs and dials at waist level. You have to bend or kneel to tune in a station. Stoves are almost invariably placed at knee level—again your wife must contort to see a roast.

Cars are designed so that a woman must back in or she'll split a tight skirt.

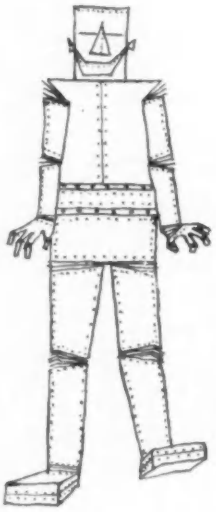
People are lazy. A lever should practically move into the hand. A switch should be where it's expected to be and move in the natural direction of hand motion.

Picture yourself using the device and imagine all the complaints (and errors) possible in operation. When your own imagination is exhausted, try your wife's. She's probably more conscious of physical problems than you are.

Is it good to look at?

Only now, when the design has proved workable and usable, can you ask if it is pleasing to the eye. Here the appearance designer should have uninhibited control—he is the expert. External contours, color masses and shapes must obey the laws of good composition, good painting, and the very complex sculptural problem of making a product esthetically pleasing from all sides.

His job is not to please you or the sales manager. His job is to attract and hold the consumer. He should be able to justify most of his decisions, but you must expect that there are areas in which you are simply not qualified to judge. If you respect his competence in other areas—why not in his specialty? **end**



MAN IS A MACHINE COMPONENT

Why not design around the man-component with full appreciation of his abilities and limitations?

DIMITRIS N. CHOROFAS, P. E.
School of Engineering and Architecture, Catholic University of America

Automation notwithstanding, few machines can operate by themselves. Whether the task is simple or complex, whether the machine is a bulldozer or a pencil sharpener, a man must be somewhere in the picture to direct and control the activities.

Let us make a daring experiment and consider the operator just another component in the system—a more complicated component than gears or dashpots perhaps, but not an unknowable or unpredictable one.

For purposes of system design, the man is a black box with inputs, outputs and certain characteristic response functions. Considering him in this way, we make a far more realistic appraisal of an operator's capabilities (insofar as the machine is concerned) and at the same time the man won't be asked to do more than he can.

Three aspects of the man-component are important to system function. First, what goes on inside the black box—what can a man actually do? Second, what environment does he require to function normally. Third, what are the relationships between man and machine and how does he fit into the machine system?

What he can do

Some tasks can be performed only by machine. Unaided, man cannot multiply two four-digit numbers in his head. On the other hand, machines cannot be programmed to make psychological or subjective decisions when unexpected emergencies arise. This is the operator's domain. In the area of overlap, where tasks can be performed by either the machine or the operator, the designer decides which tasks will be assigned to each.

Economics will probably be the decisive factor controlling the share of work assigned to man. Power-driven can openers, for example, are technologically feasible but, normally, not economically practical.

Implicit in the delegation of duties is the caliber of operator needed to run the machine. Men are ready-made components with widely varying specifications (that is, skill and training). By simplifying demands on the operator, the designer permits much greater latitude in choice of operator and lowers the cost per hour.

Further, man cannot be manipulated the same way a gear is designed or altered. Man's individual differences are wide (within a range) but a machine will behave with predictable accuracy, speed, reliability and quality of performance, independent of the peculiarities of the individual operator. Safety of operation, for instance, need not reflect the care of the worker so much as the ingenuity of the design engineer. When skill is built into the machine the result is reduced operator training time as well as an increase in the number of potential operators.

Environment

Proper environmental conditions will help the operator do his job. Good environment includes adequate lighting, air conditioning, and pleasing decoration. It

is foolish to expect fast and accurate control if the operator is uncomfortable, tired, overheated or cold. Any job requiring concentrated attention and effort had better be short in duration since no man is capable of indefinitely sustained effort.

For years medical and psychological researchers have been studying and recording data on individual human tolerances. As machines become more and more involved in our daily lives and make successively greater demands on our abilities, it becomes increasingly important to apply the available data to machine-design problems. Unfortunately, at present the data is sketchy and disorganized.

Man and Machine

Three broad areas of activity characterize human limitations:

1. Speed and selectivity are limited by reaction time and acuity of senses.
2. Static and dynamic forces are limited by muscular ability.
3. Size, shape and arrangement of control elements are limited by average arm reach, height, coordination, etc.

Again, considerable statistical information is available, although scattered. Very recently more compilations have been attempted with moderate success.

System Analysis

A four-step analysis will aid the designer in adapting the machine to the machine operator.

Step I—Answer the questions:

a. What information will the operator receive and through what sensory channels will it come?

b. What decisions must be made? (simple yes-no or complex)

c. How must he respond? (coarse or fine movements, simple or complex coordination, etc.)

d. What is the necessary environment?

e. What other requirements are necessary? (state of health, sex, age, etc.)

Step II

Using the information discovered in Step I, refer to literature concerning specific human characteristics that apply to the problem. "Human engineering" is very new, and if such information is not available, it may be necessary to consult specialists in the field.

Step III

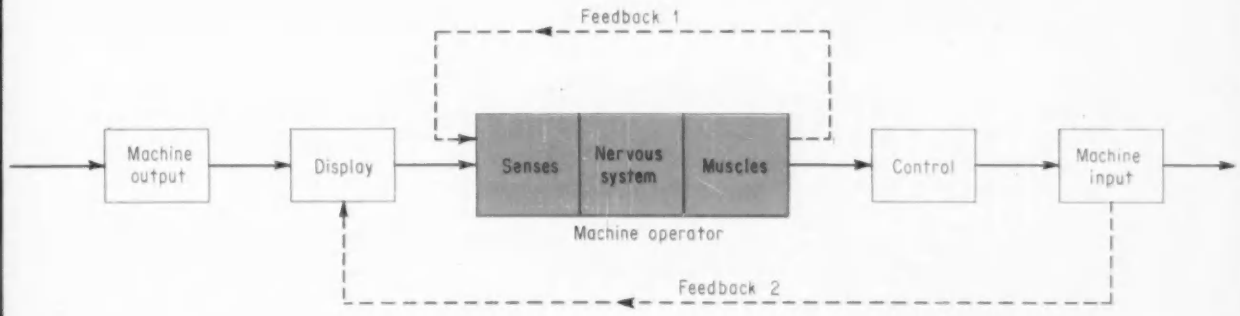
Lay out a tentative design, keeping in mind the limitations imposed by the human factors that have been discovered. Compromises will be necessary before a workable design results. Selection and training of operators may be relied upon to overcome some difficulties but cannot correct mistakes in judgment during the design phase.

Step IV

Before going into production, build a full-scale pilot model and run tests under conditions equivalent to those encountered in normal use. **end**

MACHINE OPERATORS . . .
are a vital link in the machine system. They have an input, an output, one or more feedback mechanisms and can be analyzed on the same basis as any other servo network.

Display signals, quantitative or qualitative, are received by the operator, causing same desired muscular response. Operator can monitor the muscular action directly (feedback loop 1) or indirectly (feedback loop 2).



POINTS

THE QUESTION:

"Should the US Share Scientific Secrets with Its Allies?"

DR. VANNEVAR BUSH

Chairman of the Corporation, MIT
Director of the US Office of Scientific Research and Development, 1941-46

"The Allies should not work separately . . .

. . . when Russia is working as a unit. If we want to make faster progress, we should share these secrets—definitely with Canada and Britain. Our rapid progress in developing the atom bomb during World War II was aided considerably by the free interchange of scientific information with these two countries. Now, of course, more countries are involved, and each has its own problem setting up a system that will prevent classified information from leaking to the wrong persons. Therefore, each country must be considered by itself before such a plan can be put through.

"Certainly some secrets are bound to get out when we set up such a plan. That is the chance we must take. But in the long run, such risks will be far outweighed by the benefits we will reap.

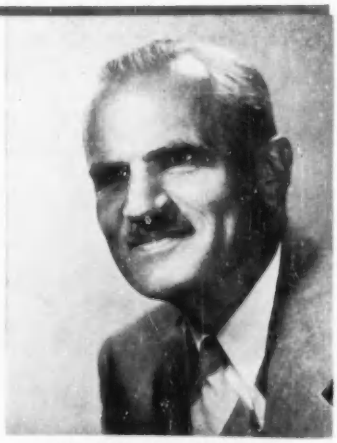
"The careful preservation of secrets is, of course, important, and we should be very energetic in keeping them. But, in my opinion, we have recently had altogether too much emphasis on this aspect of the matter, sometimes at the expense of the far more important matter of getting on with the job."

"It is in the interest of our country . . .

. . . to maintain a unity among people throughout the world. The scientists are one vital group which can assist in world unification.

"Basic scientific information is intended for all people who can use it. If there is something of scientific interest to the people, it should not be withheld. Any decision to share secrets of applied research should by all means consider the views of the scientists themselves. A group of competent scientists, working through the Department of Defense, should have the authority to evaluate the relative importance of the publication and the secrecy of any scientific discovery.

"For example, the discovery of uranium fission was merely the finding that there was chemical change in uranium in the presence of neutrons. There was no obvious evidence that this was of military importance. That was a thing regarding which the government could have formed no judgment. Only research scientists could estimate its importance. History shows that scientists have guarded most information during acute defense situations. When the researcher imparts information he is doing so because of its importance to his fellow man."



ARTHUR H. COMPTON

Distinguished Service
Professor of Natural Philosophy
Washington University,
St. Louis
1927 Nobel Prize Winner

OF VIEW

"If we think enough of our allies . . .

. . . to trust them with military and economic agreements we should trust them with our scientific secrets as well. This doesn't just mean secrets that we know Russia already has, but all secret data including the hydrogen bomb. We can't draw lines with our allies. Naturally certain material should be classified and we would expect our allies to honor this. However, there is too much fear about losing secrets or having them slip away. We try to keep too many secrets. I believe that a board made up of scientists should be established to review on a yearly basis our classified material. As soon as the board deems it feasible, the material should be released to the public and scientists at large."

DR. HAROLD C. UREY
Institute of Nuclear Studies
University of Chicago
1934 Nobel Prize Winner

LESTER B. PEARSON, M. P.
Government of Canada
1957 Nobel Peace Prize Winner
Former President of the United Nations
General Assembly

"The time has come . . .

. . . I think, when security risks—if there is such a risk now in view of what the Russians know—must be subordinated to the greater risk of the alliance weakening and disappearing.

"No continental European NATO country now has tactical atomic weapons under its own control or is manufacturing them, and the ability of the United States to make them freely available is limited by legislation. All this is a serious weakening of the principle and practice of collective defense.

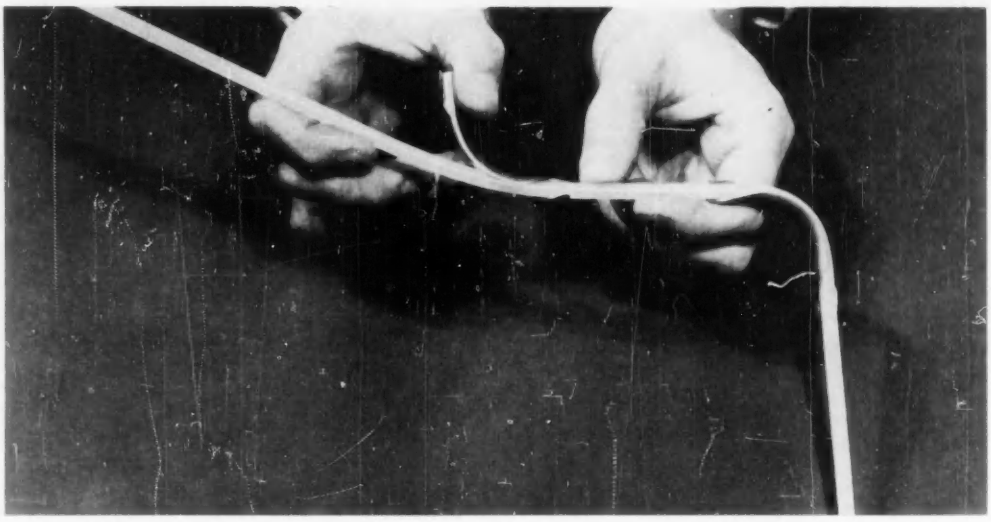
"Surely, in an alliance of this kind, every aspect of defense must be fully collective and cooperative, whether strategic or merely tactical considerations are involved; and all weapons must be shared."

"This principle is embodied . . .

. . . in the Declaration of Common Purpose made after the Prime Minister's visit to see President Eisenhower. ["The President . . . will request Congress to amend the Atomic Energy Act as may be necessary and desirable to permit close and fruitful collaboration of scientists and engineers of Great Britain, the United States, and other friendly countries."] I am in full agreement with it."

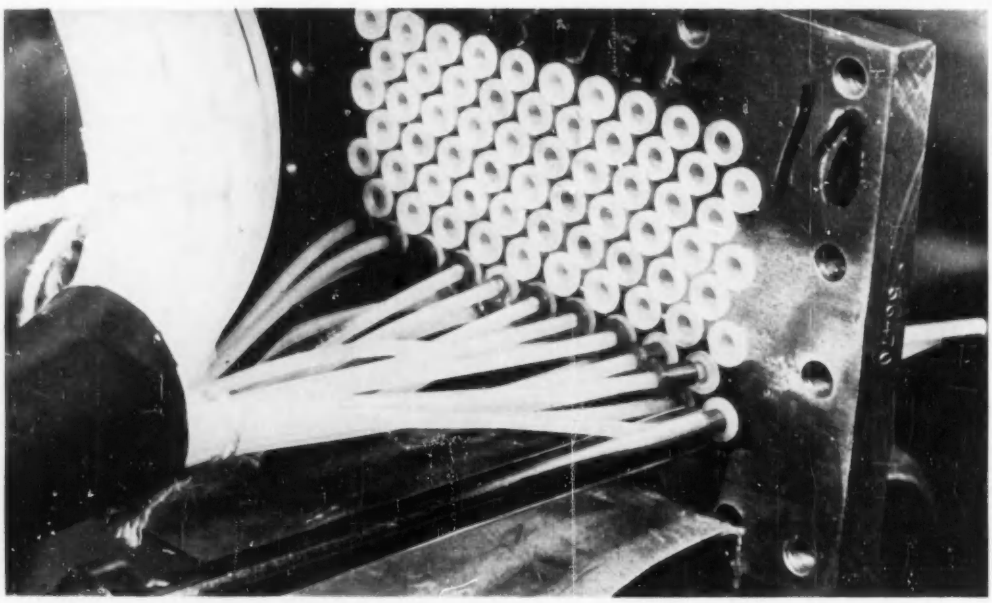
DUNCAN SANDYS
British Minister of Defense

SIGNIFICANT PARTS



Bend-holding clips . . .

for holding wiring or plastic tubing are designed to maintain a 90° bend in ¼-in. OD tubing. Bend radius is 1 in. Clip is manually attached by snapping-on, and is used to save installation time in instrumentation, hydraulic, lubrication, air or other fluid lines where quick bends are indicated. Available from stock. Clips are $7.22 per 100 in quantities of 1000 and over. **Polymer Corp. of Penna, Reading, Penna.**



Compression fitting secures tubing or wiring . . .

in panels, walls, pressure plates of electrical or fluid-control systems. Fitting has two parts, one of which is inserted in hole and the other slipped on the metal or plastic tubing and driven into place with special tool (at lower right-hand corner of illustration). Clearance between fittings can be as little as $\frac{1}{16}$ in. Made in ⅛ to ½-in. sizes. Available from stock; quantities of 1000-4000 ¼-in. size is 10.5¢ each. **Nylon Molding Corp., 141 South Ave., Garwood, N. J.**

Polypropylene plastic . . .

is a high-tensile-strength material with hardness, temperature resistance, stiffness, resilience, inertness, water resistance, low specific gravity and good electrical properties. The plastic can be shaped and fabricated by any of the industry procedures. When evaluated in existing molds, it yielded excellent parts without die changes or alterations in processing equipment. It is suitable for a large number of molded uses, as film for packaging and sheet for vacuum forming and for extrusion into fibers. Introductory price is 65¢ a lb, but as large-scale economies are realized the price should be fully competitive with other plastics materials. Adequate quantities for introductory distribution will be available after the first of the year. **Hercules Powder Co., Wilmington, Del.**

Iron-powder parts with properties similar to wrought . . .

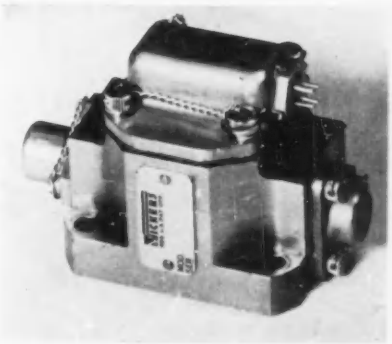
materials are compacted in regular production equipment in a single pressing at standard pressures, and then sintered to 95% density. Parts will be custom-fabricated in four alloys: 1, a 98% general-purpose alloy that can be carbonized and heat treated, yield strength 30-35,000 psi, 30-20% elongation; 2, a heat-treatable high-nickel alloy with yield strength of 68-70,000 psi, ultimate of 78-82,000 psi; 3, an alloy equivalent to 302 stainless in analysis, with 75-9000 psi yield strength, elongation 15-30%; 4, copper-bearing alloy that can be precipitation-hardened to 70-90,000 psi, with 7-3% elongation. Parts manufacturing to start early in 1958; prices comparable with parts made of electrolytic or alloy powders. **P. R. Mallory & Co., Inc., Indianapolis 6, Ind.**

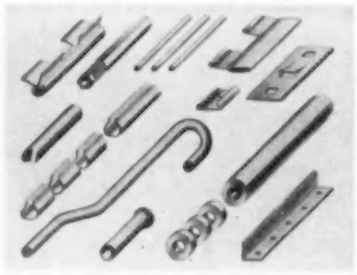
Isotactic polypropylene resins . . .

in molded, vacuum-formed and extruded shapes and also staple fibers, filaments and films are said to have unusual heat resistance, excellent resistance to solvents, acids and other chemicals, high-strength characteristics and unusual electrical properties. Products made from the material exhibit detail, high finish, have surface hardness, and are available in any color. Molecular weight and degree of crystallinity of the polymer can be varied. The new polymers are impervious to gases and vapors. The resin is produced by a type of polymerization of propylene, an asymmetric olefin. The thermoplastic material is particularly suitable for the production of colored or colorless pipes and structural shapes, sheets, transparent films, containers, cables and wire coverings. Sample quantities are now available. Price is 62¢ a lb, FOB Italian port or airport. Produced by Montecatini, Italy, the resins are available in the U. S. and Canada through **Chemore Corp., 21 West St., New York 6.**

Electrohydraulic servo valve . . .

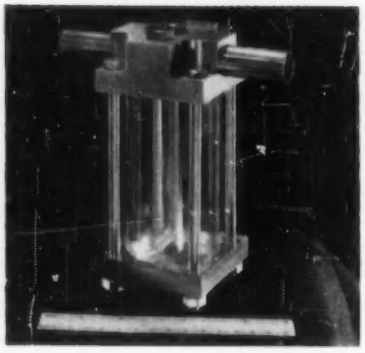
is reported to be lighter and more compact than units of same capacity, and can be adjusted while in operation. Small electrical signals actuate torque motor rated at 8 ma, which positions flapper. Then, in second stage, spool controls flow through valve. Models with 2.5 or 5-gpm capacities are available, recommended for pressures to 3000 psi and temperatures of −65 F to 275 F. Size is 3.08 x 1.75 x 1.83 in.; weight, 9.3 oz. Information on price and delivery is not available. **Vickers Inc., Detroit 32.**





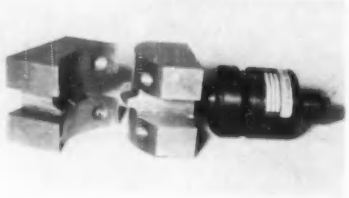
Parts made from extruded shapes . . .

are available as finished or semifinished components, cut, drilled, bent, stamped, swaged-to-length tolerances of ±0.010 in. Various plastic compounds are produced. Tooling charges for fabricated plastic extrusions usually range from $15 to $250. **Anchor Plastics Co., Inc., 36-36 36th St., Long Island City 1, N. Y.**



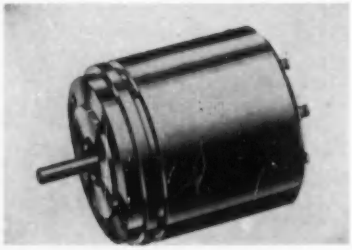
Lubricator for air systems . . .

with pressures to 600 psi has ½-pt capacity. All materials are corrosion resistant and nonmagnetic. Lubricator is Navy-approved for shipboard use, its top cap can be furnished with pipe threads or machined for subsequent brazing of tubing. **Harwood Engineering Co., Inc., Walpole, Mass.**



Explosive tool . . .

is equipped with quick-change adapters to take all blank cartridges from .22 through .45 cal. The high-strength alloy-steel unit can be used safely with cartridges developing pressures to 40,000 psi, if fired by striking a pin with a mallet. The unit is used to power small, high-speed devices such as small dies, cable cutters, and punches requiring high-velocity operation to pierce brittle metals. Used also for test purposes. Electrically operated models are available for applications requiring remote firing and for operations in which the firing impulse is provided by an automatic timer, control instrument, or electronic actuating system. **A. Dale Herman, Inc., 17017 Ventura Blvd., Encino, Calif.**

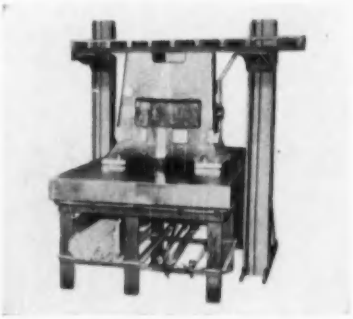


Servomotor . . .

can be adjusted to minimum control signals. Low rotor inertia, 1.0 gm cm², and high stall torque, 1.45 oz-in., provide acceleration at stall of 100,000 radians/sec². Torque-speed curve is linear from stall through no-load speed. Fixed windings operate from a 115-v, 400-cps source or can be wound for any standard carrier supply. Teflon wire and insulating materials enable the unit to operate continuously at total unit temperatures to 392 F. Withstands 100-g shock and 30-g vibration to 2000 cycles. Weighs 8 oz. Motor housing shaft and ball bearings are stainless steel and all windings are fully encapsulated. **Helipot Corp., Newport Beach, Calif.**

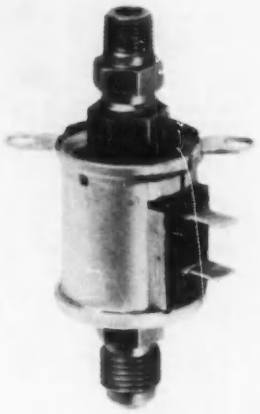
Shielded zipper tubing . . .

provides a shielded casing for multiconductor wiring or cables. The material is a plastic-saturated glass-fiber backing, laminated to aluminum, lead or magnetic foil. The laminated metal foil grounds RF and UHF at a fraction of the cost of conventional tin or copper shielding with outer jacket, according to the manufacturer. Emergency or field maintenance is easy because of the zipper-type slide fastener. The tubing weighs less than conventional shielded harness and is available with overlap construction that offers full coverage plus storage in flat form. Available in sizes ⅜ in. OD and larger in ⅛-in. increments and in wall thicknesses of 20, 40 and 60 gage. **Zippertubing Co., 750 S. San Pedro, Los Angeles.**



Lightweight tooling bridge equipment . . .

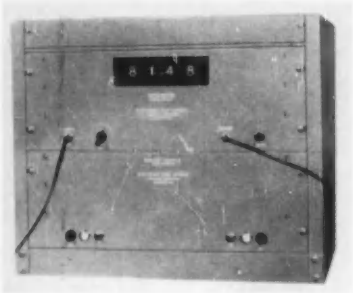
provide three-dimensional measurement of irregularly-shaped objects, such as models, prototypes, tools, dies or finished stampings or castings. A typical setup consists of a semi-steel base unit and magnesium vertical and horizontal units that can be moved in any position. Base plates, uprights, platform angles, parallels and sliding angles of various types are available. **Challenge Machine Co., Grand Haven, Mich.**



Inexpensive solenoid valve . . .

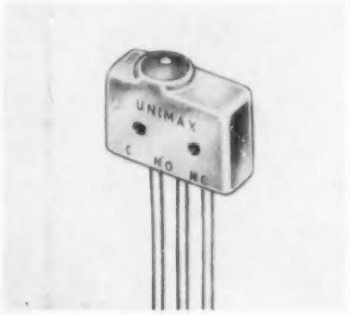
for use on air, water or oil has straight-through flow through the solenoid armature housing. The valve, about 2 in., is resistant to moisture, and is suitable for use with edibles and corrosive materials. Several models have Monel and stainless

parts. Solenoids in all models are encapsulated in epoxy resins. A variety of end fittings are available to meet specs. **Fulton Sylphon div., Robertshaw-Fulton Controls Co., Box 400, Knoxville 1, Tenn.**



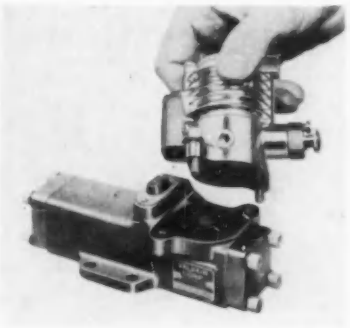
Interval meter. . .

counts, samples, stores and provides a working output without stops in the count for sampling and with no loss of time between samples. Information is transferred from counter to storage output in less than 50 microsec while the counter resets automatically to accept the next sample. Storage output continuously displays the last count sampled. The four-decade instrument is in a standard rack mount and has a max counting rate of 100 kc, with a 5-v input signal. A 40-v, 2-microsec transfer pulse is required for sampling. The storage readout is applicable to machine control, automation, telemetering and nuclear-reactor control. Provisions have been made for relays, numerical indicators and printers. **Electronic Tube Div., Burroughs Corp., Plainfield, N. J.**



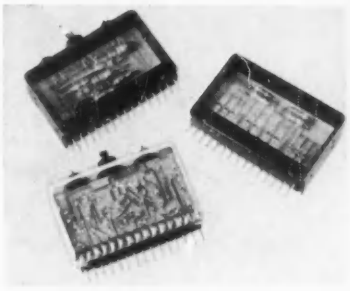
Subminiature switch . . .

is sealed against dirt, water, or oil. Operating element is enclosed in an aluminum housing and is embedded in an epoxy resin. An elastomer seal, bonded to the operating pin and to the metal housing, permits free movement of the pin, yet keeps out foreign matter so effectively that the unit can be operated immersed in liquid, or it can be used in high-altitude applications at max rating for short periods. Furnished with three insulated wire leads to specified length, or with wire loop terminals. Auxiliary actuators can also be provided. Over-all dimensions are $\frac{7}{8}$ x $\frac{1}{2}$ x $\frac{11}{16}$ in. Electrical rating is 5 amp at 125 to 250 v ac or 30 v dc, resistive; $2\frac{1}{2}$ amp, 30 v dc, inductive. **Unimax Switch, Div. W. L. Maxson Corp., Ives Rd., Wallingford, Conn.**



Plug-in four-way control valves. . .

have built-in plug connectors for automatic connection of electrical circuits. Plugs and connectors incorporated in solenoid pilot valve body and manifold or sub-base complete all electrical circuits automatically when the unit is placed in mounting position. The $\frac{1}{4}$-in. valves are for control of smaller devices and are available in single and double-solenoid types, for manifold or sub-base mounting. Bodies are of Navy M bronze, and caps of stainless steel, and stems and O-ring packers of hard, chrome-plated stainless. Solenoid pilots are built to JIC standards. Service life is said to exceed 25 million cycles. Designed for 30 to 250-psi air service. Solenoid coils for ac or dc are available, any voltage. Cylinder ports and inlet are tapped $\frac{1}{4}$ in. NPT; exhaust is tapped $\frac{3}{8}$ in. NPT. Available for shipment from stock. **Valvair Corp., 454 Morgan Ave., Akron, Ohio.**

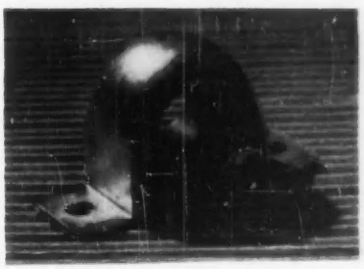


Miniature, packaged circuits . . .

include eight basic building blocks, all measuring $2\frac{1}{4}$ x 2 x $\frac{1}{4}$ in. It is reported that no air conditioning is needed in computers designed with the units. Types include bistable trigger element, monostable element, gated amplifier, complementer amplifier, "Or" gate, "And" gate, "And-Or" gate, emitter follower package. Elements operate over a temperature range of —58 to 185 F. At temperatures above 77 F, some derating of load current and switching speed is necessary. Solder lug or dual-output mounting sockets are available. Rack-mounting chassis can be supplied using either type socket for flush, recessed or enclosed mounting with interconnecting terminals located either front or back. Each rack is $3\frac{1}{2}$ in. high, holds 25 building blocks and fits a standard relay rack. **Avco Research and Advanced Development Div., 20 S. Union St., Lawrence, Mass.**

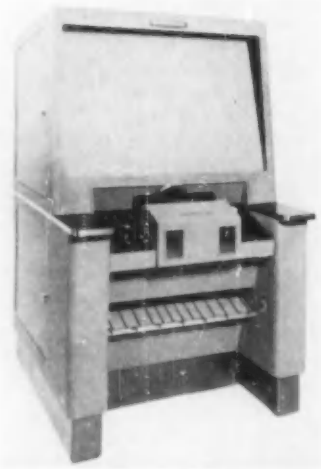
Hydraulic remote control system . . .

incorporates an integral filler-bleeder fitting that eliminates accessory pressure equipment. Time required to fill the system with oil, and bleed it of air, is greatly reduced. An adjustment of equalizer valves permits relative positioning of master and slave levers when filling and bleeding have been completed. System provides positive remote control of valves, clutches, transmissions, throttles, governors, conveyor gates and similar devices. Master control lever and remote actuator lever maintain synchronization through 114° arc with 500 in.-lb full hydraulic output in either direction. No pressure-actuated or spring-loaded valves are used. Can be mounted in any position. Unaffected by vibration. **Hydronic Co., 12685 Arnold Ave., Detroit 39.**



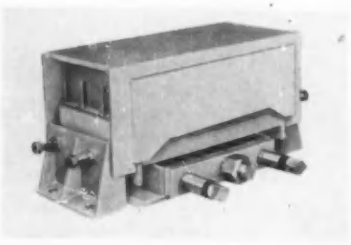
Selfaligning pillow blocks . . .

are designed to run dry or submerged in any fluid that will not corrode the cadmium-plated steel housing. Can be used to 650 F. Cannot be used under shock or severe vibration. For $\frac{3}{4}$-to-$\frac{1}{2}$-in. shaft dia. Made from carbon and graphite powders and carbonaceous binders. Has low co-efficient of friction ranging from 0.04 to 0.29 depending on grade, mating material and operating conditions. Materials are resistant to almost all industrial chemicals. They are attacked only by hot, concentrated oxidizing agents. **Electro-Nite Carbon Co., 8601 Torresdale Ave., Philadelphia 36.**



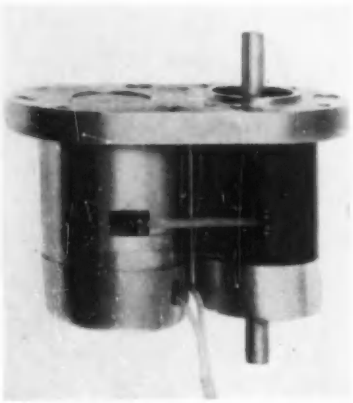
Viewer, enlarger, processor . . .

produces 18 x 24-in. working prints from unitized microfilm. A single pushbutton control activates the unit, which automatically delivers prints to operator in less that 1 min. It selectively reproduces a paper print from the microfilm image on file or aperture cards to 3¼ x 7⅜ in. The finished print can be on standard-weight or translucent paper. Magnification is 20x for viewing, and 15x for enlarging. Viewing screen is 24 x 36 in. Developer section is removable for cleaning and replenishing of developer. The 500-w light source is blower-cooled for film protection. Unit weighs 700 lb, is 65 x 40 x 42 in. deep. Machine operates on 110 v ac, 60 cps. **Ozalid div., Aniline and Film Corp., 11 Corliss Lane, Johnson City, N. Y.**



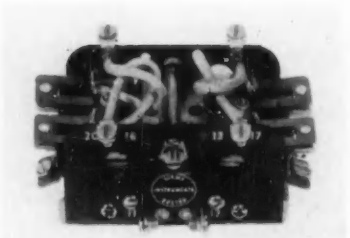
Machinery mounts . . .

for vibration, shock and noise-isolation use steel springs as the isolation medium. Currently available in seven load-carrying capacities from 38,000 to 125,000 lb each. Lengths range from 20 to 35 in.; widths from 12 to 20 in. Mounts are adjusted and leveled from the side, rather than by a bolt protuding from the top. The clean, flat top permits placing the unit in any position under a machine base to provide max support. Shims are not needed to level installations. An internal device facilitates leveling the machine installation with less torque than is necessary when the adjusting bolt works directly against the load. Housings are heavy-duty welded steel with high-carbon, helical-steel springs. **Korfund Co., Inc., 48-19C 32nd Pl., Long Island City 1, N. Y.**



Clutch package . . .

includes mechanical pulse amplifier, indexing clutch and an electrical transducer. Mechanical and electrical delays in unit are predetermined. Mechanical delay is as low as 0.001 sec; electrical delay is 0.0035 sec; combined delay of 0.0045 sec. Pack consists of indexing clutch, power pack, servo bracket with mounting hardware and a nylon link. Power pack is available for different voltage levels. Choice of an index rate of 1, ½ or other fraction of a revolution, clockwise or counter-clockwise rotation is available. Standard is 60 cps, with higher speeds in special designs. **Digitronics Corp., Albertson Ave., Albertson, L. I., N. Y.**

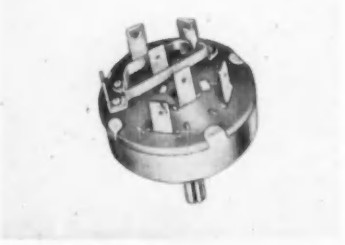


Polarized, latching power relay . . .

switches 1-to-2-kw loads in response to momentary ¼-to-½-w signals. Uses a permanent-magnet latch in place of mechanical-latching devices to eliminate all but one moving part and thus lengthen relay life and increase resistance to shock and vibration. The DPDT relay has four separate contact circuits and is available as a single coil, two-position bias unit or single or dual-coil, two-position, magnetic latch-in. Armature is normally closed. Nominal contact rating is 20 amp resistive at 28 v dc or 120 v ac, with standard sensitivities of 225 or 245 milliw. Min life is 100,000 operations when operated not more than once a sec. **Sigma Instruments, Inc., 48 Pearl St., South Braintree 85, Mass.**

Two-way restrictor valves . . .

weigh 0.143 lb in ¼-in. size, and are as small as 2 7/16 x 0.688 in. hex. Stainless steel valves meter flow at a given rate consistent with inlet and outlet pressure conditions. Metering is controlled by a sharp-edged orifice, with uniform flows in both directions. Typical applications include the control of actuation rate in hydraulic or pneumatic devices and control of gas or liquid-charging systems. Metal-to-metal seals are used. Models are available with ports per AND10050, AND10056 or MS335k4, for line size of ¼ in., ⅜ in., or ½ in. Filter openings from 0.008 to 0.012 in. **A. U. Stone & Co., Inc., 23 W. 60 St., New York 23.**



Motor-reversing switch . . .

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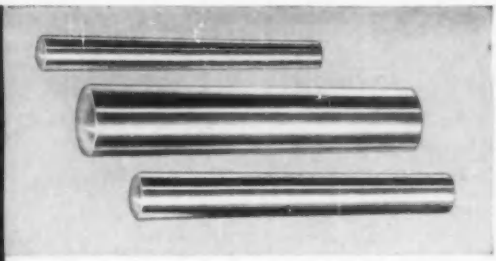

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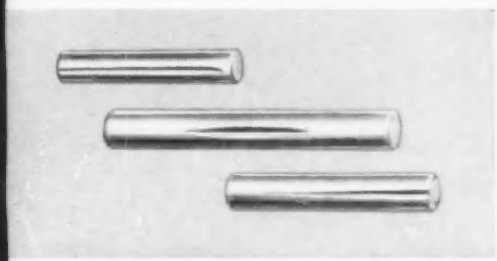

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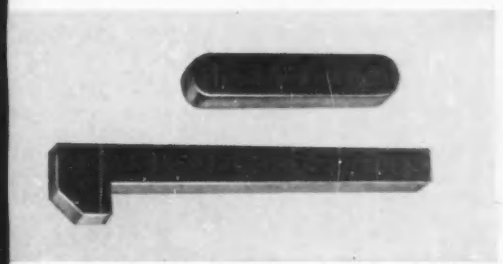

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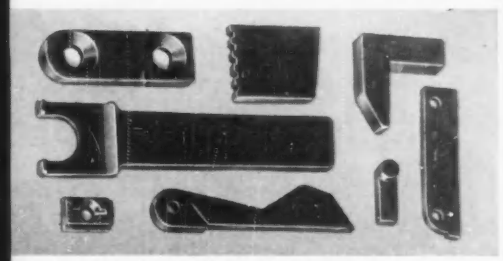

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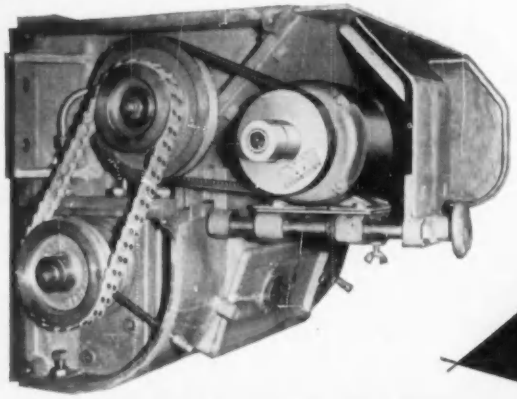

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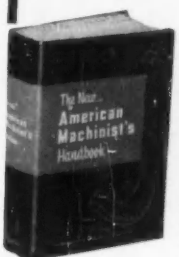

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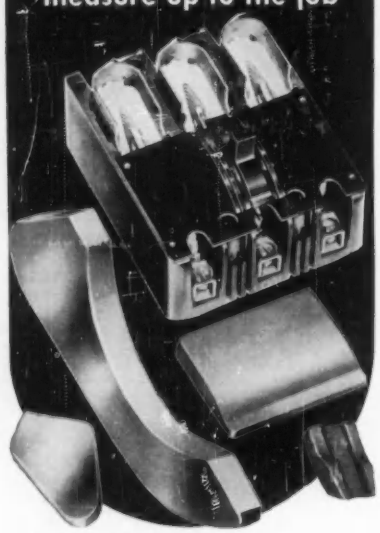

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29-30 **Midwest Welding Conference,** sponsored by Armour Research, Illinois Institute of Technology, and Chicago section, American Welding Society, at Illinois Tech Chemical Building, 3255 Dearborn St. For information contact Harry Schwartzbart, 10 W. 35th St., Chicago.

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4-6 **Society of the Plastics Industry,** Reinforced Plastics Div., Technical and Management Conference, Edgewater Beach Hotel, Chicago. For information contact the Society, 67 W. 44th St., NYC.

MAR.

3-6 **ASME Gas Turbine Power Division,** Conference and Exhibit, Shoreham Hotel, Washington. Exhibits are limited to gas turbine power plants, component parts, materials and accessories. For information contact ASME, 29 West 39th St., NYC.

12-14 **Pressed Metal Institute,** Spring Technical Meeting, Sheraton-Cadillac Hotel, Detroit, Mich. For information contact the Institute, 3673 Lee Road, Cleveland, Ohio.

16-21 **4th Nuclear Engineering and Science Conference** managed by American Institute of Chemical Engineers with participation of ASME, AIEE, American Institute of Mineral, Metallurgical and Petroleum Engineers, at International Amphitheater, Chicago.

17-20 **ASME Aviation Division,** Conference at Statler-Hilton, Dallas, Tex. For information contact the Society, 29 West 39th St., NYC.

19-20 **ASME Committee on Management** Conference, Somerset Hotel, Boston, Mass. For information contact the Society, 29 West 39th St., NYC.

24-27 **IRE National Convention** and Radio Engineering Show, Waldorf-Astoria Hotel and New York Coliseum. Program includes 275 papers covering fields of all 27 IRE professional groups. 850 exhibitors are participating in the show. For information contact E. K. Gannett, 1 East 79th St., NYC.

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2-4 **ASME Instruments and Regulators Div.,** 4th annual conference with participation by AIEE, IRE, ISA, and AIChE at University of Delaware, Wilmington. Four technical sessions and a panel discussion will be supplemented by plant visits. For information contact L. Bertrand, Engineering Service Div., Louviers Building, E. I. Du Pont de Nemours, Newark, Del.

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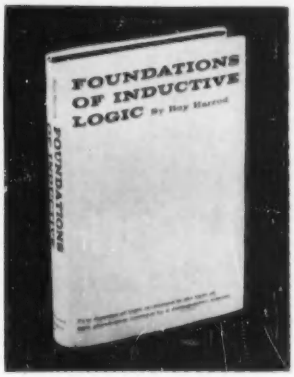

NEW LITERATURE

Foundations of Inductive Logic

ROY HARROD, *Student of Christ Church. Published by Harcourt, Brace and Co., Inc., 383 Madison Ave., NYC. 5½x8¾, 290 pp. $7.*

Logic has been traditionally divided into deductive logic and inductive logic. Inductive logic is argument based on experience of the physical world. It is used daily. Scientific reasoning depends on it. Hitherto, unlike deduction, it has had no satisfactory philosophic basis: its validity has never been demonstrated with logical rigor. Many philosophers and logicians have doubted that such a demonstration is possible. This, however, is what the author now attempts—by relating induction to the theory of probability.

Probability theory has won great acclaim in recent years by being brought into service first in statistical mechanics and then in quantum mechanics, as well as in other sciences, and the problems of physics have stimulated further its development. Here the probability theory is used as a branch of deductive theory—the middle step in the hypothesis—deduction-verification procedure. A hypothesis is framed that certain entities defined in physics behave according to statistical laws.

Statistical theory is then used in a deductive process that traces out the consequences of the hypothesis, stating what should be observed in defined circumstances if the hypothesis is true. As before, if observations jar, the hypothesis will come up for revision, subject to the accuracy of the deduction being checked. But it seems that work done by probability theory is inside the deductive member of the trinity of hypotheses, deduction and verification.

The book also discusses general uses of induction in philosophical problems. The final chapter discusses conclusions induction permits us to draw about the world that lies beyond our sense. —NC

Men and Vibration

Abstracted from "Vehicle Vibration—Man's New Environment," by A. O. Radke, Bostrom Research Laboratories, ASME paper 57-A-54, presented at ASME Annual Meeting, New York, Dec. 2-6.

Man has adapted himself to, or has found compatible, the low-amplitude, low-frequency motion of walking. Where he has exposed himself to other sources of vibration—that is, until the present automotive-air age descended on him—he has been able to minimize their effect by limiting the speed at which he traveled (limiting the vibration intensity) or using his legs as a vibration isolator. (The charioteer stood; the horseman stood in his stirrups or posted). In any case, the number of people exposed was not significant and the duration of their exposure was brief.

In our environment, however, man very often is exposed to vibration for which he is not physically prepared and, because of the requirements of the vehicles, is not permitted use of his legs to minimize the effect, nor allowed to control the intensity of vibration. In addition, his exposure to this vibration is no longer brief, but in many cases continues all day long, day in, day out. A study of such effects is described.

Organizing for Product Development

These five papers discuss various aspects of the problem, ranging in subject matter from research-engineering relationships to an account of the development of an actual product prototype. All of the papers were delivered at the 1957 ASME Annual Meeting in New York, Dec. 2-6.

"Relationship Between Engineering and Research in a Medium-size Multiproduct Company" is by W. R. Spiller, Harris-Seybold Co., ASME paper 57-A-235. The concepts of research and engineering are defined and their relationships considered. The important differences between these functions, the resultant effects on the type of personnel required, suitable facilities, and a reasonable organizational structure are discussed.

"Product Development and Engineering Co-ordination for Accomplishment in a Medium-size Company" by W. R. Hough, Reliance Electric & Engineering Co., ASME paper 57-A-236. This paper discusses the co-ordination problem between product development and engineering in the matter of total engineering responsibility. The paper also considers the type of organizational structure as it affects co-ordination.

"Meeting the Engineering, Research and Development Needs of a Medium-sized Company" is by K. R. Herman, Vickers Inc., div. Sperry Rand Corp., ASME paper 57-A-161. Describes reorganization of research activities of this company, which is primarily engaged in hydraulic equipment manufacturing.

"Product Development—From Research to Production" is divided into two parts. Part 1, "Research Cracks the Taste Barrier" is by Albert M. Rockwood, Battelle Memorial Institute, ASME paper 57-A-147. Causes of high mortality of proposed new products are discussed and suggestions are made for improving the chances for profitable product development work. The steps of a successful product development program are traced in the history of a large-volume production appliance—an automatic tea maker for restaurants.

Part 2, "The Tea Maker from Prototype to Production" is by V. K. Viitanen, Food Machinery Corp., ASME paper 57-A-145. The story of the engineering and the field testing of prototypes to establish design and specifications for an acceptable production model of the tea-making machine is described.

ENGINEERING AND PRODUCTION SERVICES—Brochure, 32 pp, describes organization with experience in aircraft, missiles, instrumentation, tooling and construction able to provide product-development services from idea to finished goods, including research, mockup, prototype, testing, planning, tooling, production. Nicholson Industries, Box 487, Coffeyville, Kans.

HYDRAULIC FLUIDS—Bulletin 1300-SA, 24 pp. Selection, operation and maintenance of hydraulic fluids for industrial machinery is the subject. It describes characteristics of petroleum-base and fire-resistant hydraulic fluids. Gives trouble-shooting tips. Vickers, Inc., Box 302, Detroit 32.

DATA REDUCTION SYSTEMS—Catalog 30A1200, 6 pp. Describes and illustrates operation and characteristics of data logger and scanner with building-block construction and pinboard programming. Fischer & Porter, 464 Jacksonville Rd., Hatboro, Penna.

NEEDLE VALVES—Brochure, 4 pp. Presents two new lines of needle valves. With cutaway drawings, diagrams, specs and dimensional data. Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh 22.

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Publisher's Postscript...

R & D—Our Secret Weapon

We have seen a tremendous expansion in the field of product manufacturing the last ten years. A great many small companies joined larger enterprises, and many other companies expanded or diversified their operations.

The underlying methods of operation of these enlarged companies, especially as they pertain to product development, are guided by two distinct schools of thought. One group believes in centralizing all of its product research, design and development in one engineering headquarters, while the other believes engineering and development work should be conducted close to the plant that is building the product.

There is much to be said for centralization—especially when completely equipped with the necessary shops and testing facilities. Companies with multiple-plant operations, but whose products fall into one field or closely related fields, have found centralization of research and product development particularly advantageous. They can accumulate much more extensive equipment for testing and model development, and take advantage of the broader experience of a larger and more diversified staff. They can also develop new designs with less leakage to competition.

The trend seems to be definitely toward the centralized facility—usually located in an area where other similar but noncompetitive operations are located. This provides greater attraction to engineers and technicians and more frequent exposure to the competent engineers of suppliers.

But concentration of such facilities in any compact area has definite drawbacks from the military standpoint. They could be major targets for an enemy. It is becoming more and more important in our planning not only to consider the values important to us in relation to our own businesses, but also to think about the possible hazard of a location in time of war.

Plans for centralized product research and development facilities are being studied by many large organizations, but in considering the many advantages in bringing the best brains together, the matter of location should be studied as well.

The research and product-development facilities of American Industry are the nation's secret weapon. Only through their achievements can we improve our international strength. Let's continue to build the best facilities in the world, properly located in relation to our businesses, but let's also remember the lesson we should have learned at Peenemunde.—AH

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New York 36 . . . B. K. Adams, J. C. Taney, R. C. Kennedy, 500 Fifth Ave., Oxford 5-5959

Philadelphia 3 . . . D. G. Jones, K. S. Willadson, Architects' Bldg., 17th & Sansom Sts., Rittenhouse 6-0670

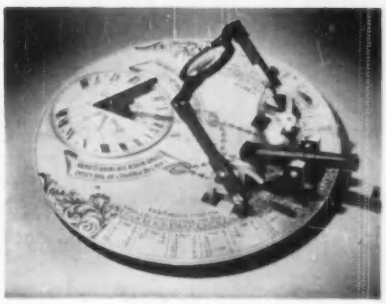
Pittsburgh 22 . . . C. F. Leveroni, 1111 Oliver Bldg., Atlantic 1-4705

St. Louis 8 . . . A. E. Meanor, 3615 Olive St., Continental Bldg., Jefferson 5-4867

San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600

74 for Your Information (personal)

You command, sun obeys



If you want a purely personal (and automatic) one-gun salute, it can be had now—thanks to solar energy, explosives, and an ingenious design engineer. The gun mounted on this sundial takes a real powder charge. At high noon (or another time determined by angle of the lens that focuses sun rays), the powder heats up and the gun goes off. While this may not sell fast at its price of $125, it does show what can be done with explosive power—a form of energy receiving close attention from designers of machine tools, hand tools, processing equipment, missile and aircraft auxiliaries. (PE—Jan. 6, '58).

Fish—and play ball

The trend toward multipurpose electrified tools gets stronger all the time. This time, it's the fisherman-golf player who benefits. He gets an electric fish scaler that looks like a portable power drill, and has a 110-v, ac-dc power head. It not only features a plastic shield and reel-buffing, grinding, and polishing attachments, but also a golf-club deburrer. Price: $19.95. Abercrombie & Fitch sells it.

For the long, long road

Distances are great in Canada—which may explain why this souped-up version of the pedometer is made by Dominion Electrohome Industries, Ltd., Kitchener, Ont. It's a good example of how applying latest technology to an old idea can create a new product—and command a good price ($85). Called "Trumeter," it has a counter that reads directly in feet. The wheel is cast iron; but, as Kaiser Aluminum proudly points out the telescoping handle, wheel forks, and scraper are all made of its favorite metal.

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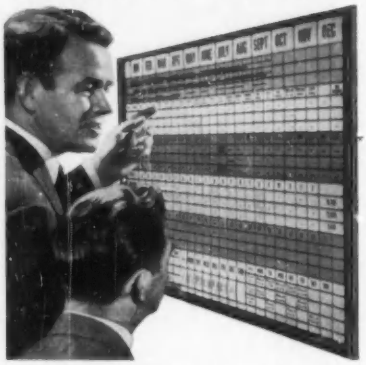

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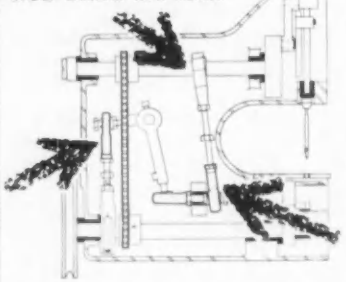

EXAMPLE: The Minneapolis Sewing Machine Co. uses three Heim Unibal Rod Ends in the linkage of their Portable Sewing Machine to take care of a 25° operating misalignment.

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WHY DON'T THEY RESEARCH and DEVELOP...

. . . an inexpensive lightmeter to be mounted on automobiles so that headlights and tail lights are turned on automatically at dusk. The system would function whenever the ignition was turned on—to prevent forgetful motorists from leaving a parking area and merging with traffic in unlighted vehicles. The lightmeter would have to be installed so that street lights would not affect it. —D. D. WELBAUM

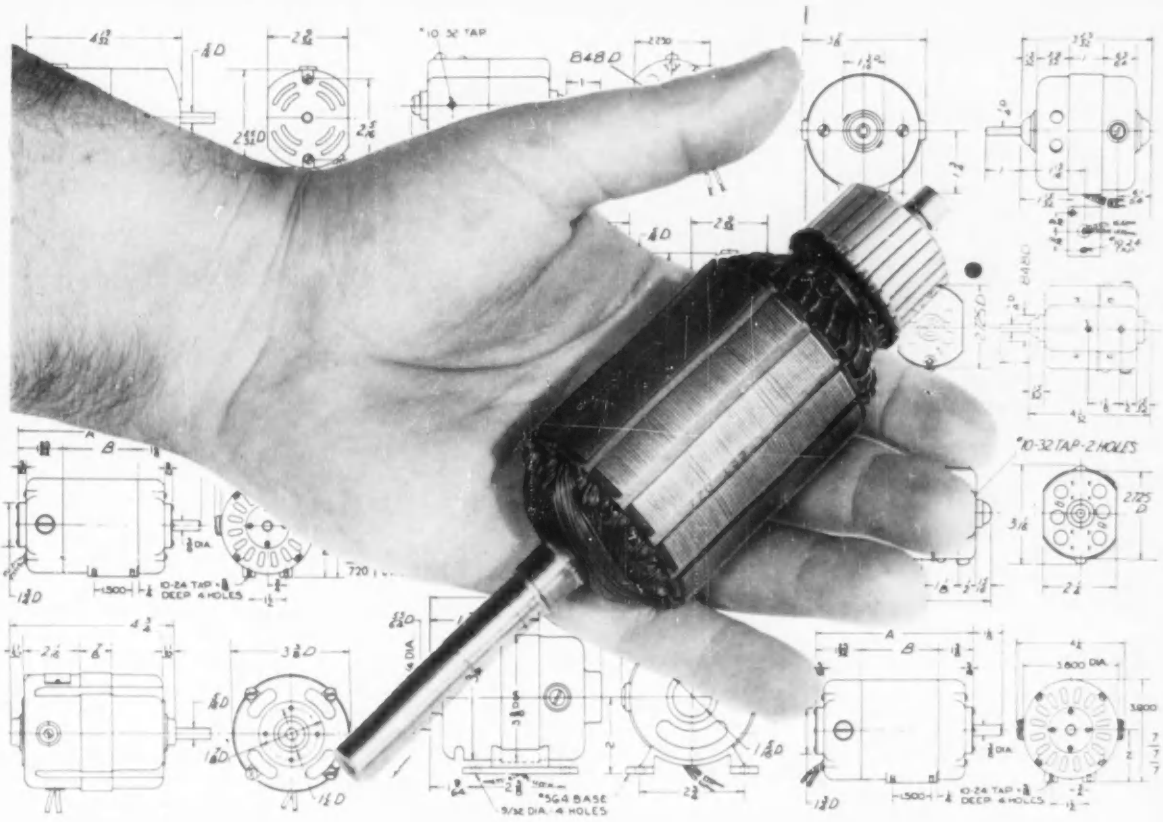
. . . a seal strip for the open edges of magazines like PRODUCT ENGINEERING to protect them from damage in the mails. A tear strip would be incorporated for easy opening by the reader. An added benefit would be reinforcement of the covers which are often mutilated in use even if they arrive in good condition.— KENNETH KAHN

. . . an ear plug that is comfortable and really cuts noise. Most plugs on the market don't fit well (which is no surprise—no two ears are even similar). Besides, the waxed cotton balls now available are relatively inefficient noise attenuators and tend to slip out easily when body heat softens the wax. How about a hygroscopic material that would swell slightly to fit the ear more closely? It might be reconditioned by heating over a radiator or stove. Most important, however, is the ability to attenuate noise and to do so it will have to be porous. Experiments with the newer plastic-foam materials might bear fruit. —H. BELOFSKY

. . . a plastic mercury-bulb thermometer. Glass thermometers are fragile, relatively expensive when accurate, and somewhat difficult to read at any distance. Although plastic would have a higher coefficient of expansion than glass, a low-expansion metal insert could be molded around the mercury reservoir, and the stem similarly reinforced by an insert. For clinical mouth thermometers plastic would be less grating on the teeth and less likely to break because of its flexibility.

—H. BELOFSKY

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer



No "Shorts" or "Opens" in these Zanderoll Processed Howard Universal and D.C. Fractional H.P. Motors

One of many advanced production methods at Howard, the Zanderoll process provides armatures with deep, uniform varnish penetration for high bond strength and rock hard coils, thus reducing to an absolute minimum, "flying shorts" and "opens".

Here's how the Zanderoll process works to insure steady performance in Howard motors: Tightly wound armatures are automatically rotated through a series of two varnish dips and two baking ovens—mounted so that only the coils and laminations are varnished. The first varnish coat is thoroughly baked before application of the second, insuring a deep, even bond. This enables an armature to be mounted to close tolerances with the field.

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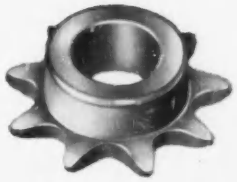
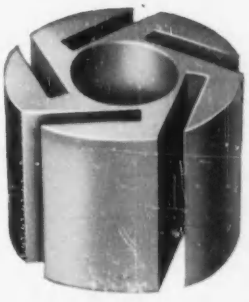


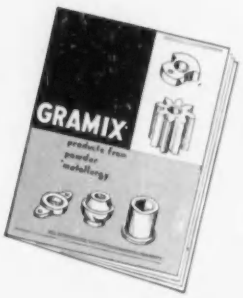
Hardened steel drive sprocket for lawnmower

Iron switch control



Rotor for gasoline pump

Packing gland follower used in hydraulic system



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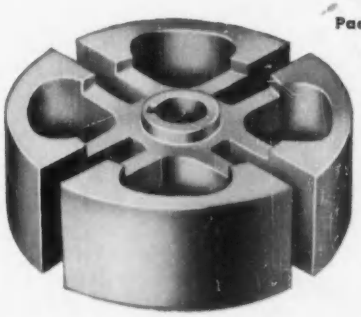

Bronze rotor in high speed fueling unit

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